AIR CONDITIONING HEATING AND VENTILATING

For the Engineer
Engaged in DESIGN
APPLICATION
ESTIMATING
SPECIFICATION
and LAYOUT
for
AIR CONDITIONING
HEATING • VENTILATING
PIPING • PLUMBING

SEPTEMBER, 1961

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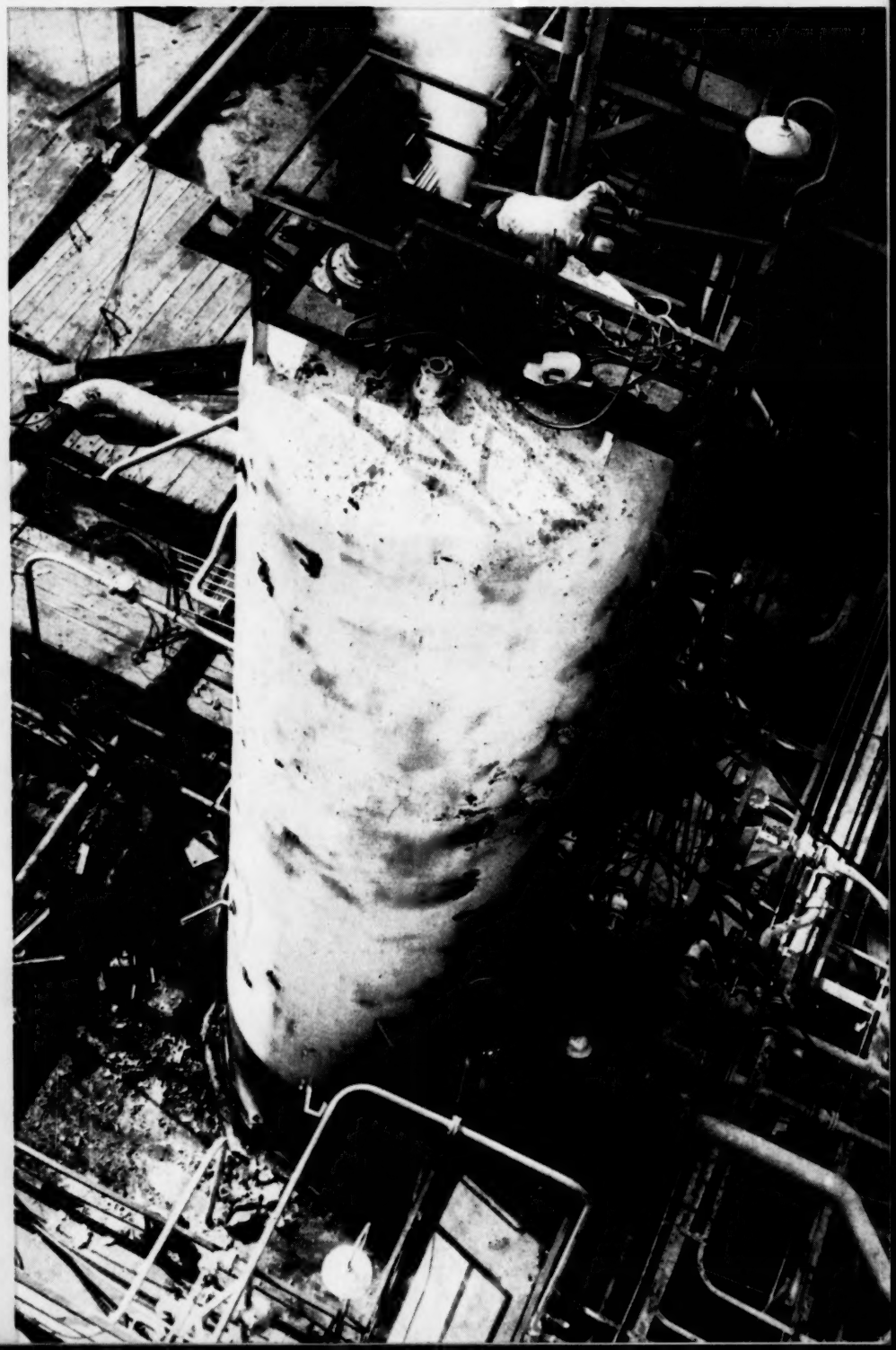
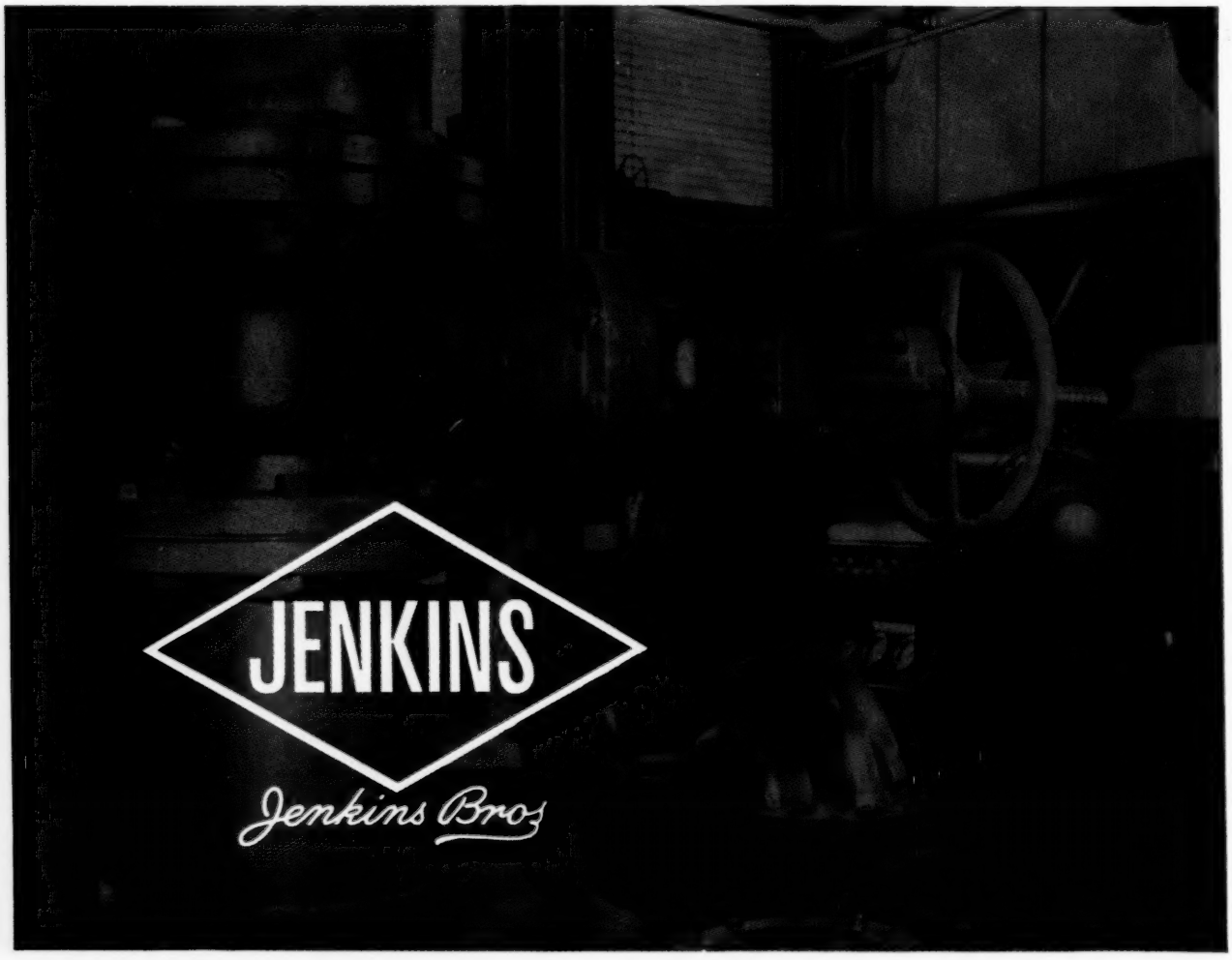


Studies of torch cutting in this 10 foot dia settler drum helped to establish better ventilation methods for close-quarter work spaces. See this month's Reference Section, beginning page 73.



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Why a Steam Trap Has to Handle "Air"

Low temperatures and corrosion of equipment are often evidence of inadequate trap air venting capacity

Air, with its load of oxygen and carbon dioxide, has an unwholesome habit of interfering with the efficiency of steam heated units. If steam were always free of these undesirable companions, things would be a lot simpler for men-who-operate-plants. Because it isn't, three unhappy situations frequently occur:

1. ***Operating temperatures are subnormal.*** This is a two-part problem. First, an air-steam mixture has a lower temperature than pure steam at the same pressure—see Table A. Secondly, air can "plate out" on heat transfer surfaces as shown in Figure 1. Under some conditions, such an air film will knock down heat transfer efficiency by as much as 50%.

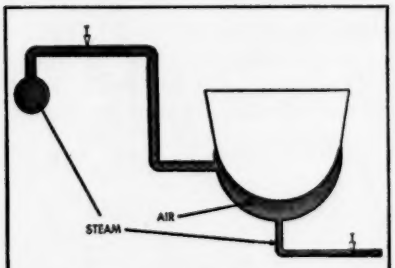


Fig. 1. *How air can "plate out" on heat transfer surfaces. This "insulation" drastically reduces heat transfer efficiency. Armstrong trap operation creates turbulence in the equipment that prevents this.*

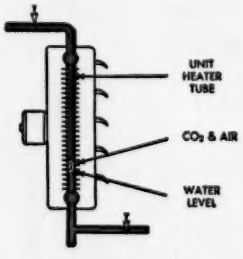


Fig. 2. *Corrosion occurs when units are not kept continuously free of both condensate and air. Armstrong traps discharge both,* at steam temperature, *as fast as they accumulate.*

2. ***Corrosion rears its ugly head.*** Oxygen and carbon dioxide are real trouble-makers. CO_2 gas goes into solution in condensate, forms carbonic acid and chews away at vulnerable metal sections. O_2 aggravates the situation. See Figure 2.

TABLE A—How air reduces steam temperature.

Gauge Pressure	Temp. of Steam with No Air Present	Temp. of Steam Mixed With Various Amounts of Air (% Air by Volume)	
		10%	30%
10.3	240.1	234.3	220.9
25.3	267.3	261.0	246.4
50.3	298.0	291.0	275.1
75.3	320.3	312.9	295.9
100.3	338.1	330.3	312.4

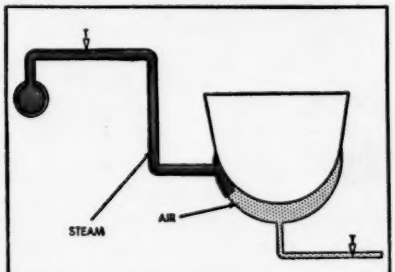


Fig. 3. *When steam is turned on, it takes a trap with extra air venting capacity to provide fast heat-up.*

3. ***Heat-up is slow as a snail.*** Air has a picnic in units that are shut off periodically. Figure 3 pictures the problem. Lines and equipment literally fill up with air. When the steam is turned on it can get in only as fast as the air gets out.

Enter Steam Traps

Curing these steam system ailments involves an operation sometimes called a "trap transplant." It consists of removing traps that don't get the air out and replacing them with traps that do.

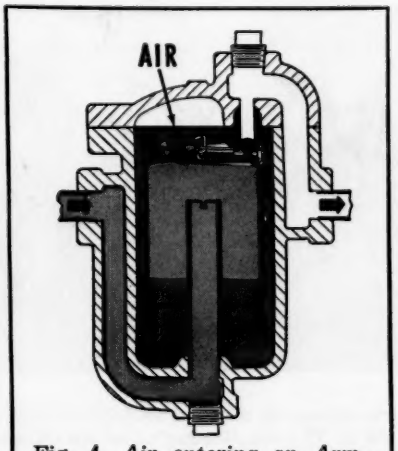
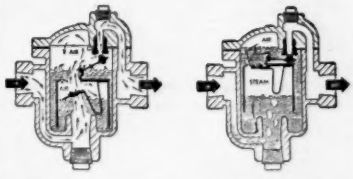


Fig. 4. *Air entering an Armstrong trap passes through the bucket vent and accumulates in the top of trap. When trap opens, air is discharged along with condensate.*

Figure 4 shows how an Armstrong inverted bucket trap continuously vents air. What the picture doesn't show is a built-in plus-value of this trap's design. An Armstrong trap opens suddenly, creating a momentary pressure drop and turbulence in the unit being drained. This breaks up air films and "pumps" air down to the trap so it can be vented.

The vents in standard Armstrong trap buckets will pass all the air normally encountered. In special cases, such as paper machine dryers, the vents are correctly sized larger at the factory to meet the requirement.



Thermostatic vent open. *Thermostatic vent closed.*

Fig. 5. *Open float with thermostatic vent for off-and-on units. When trap is cold, vent is open, permitting air to blow through when steam is turned on. When steam reaches trap, heat closes thermostatic vent. Then, regular bucket vent handles all air coming in with steam.*

Open Float with Thermostatic Vent

Super air-venting capacity is a must for fast heat-up of low pressure unit heaters, heating coils, steam headers and other units that are on-and-off. Figure 5 shows how the Armstrong open-float-with-thermostatic-vent trap takes care of this.

* * *

The 44-page Armstrong steam trap book covers other features of the Armstrong trap as well as its excellent air handling characteristics. This catalog also discusses trap selection, installation and maintenance. Your local Armstrong Representative or Distributor will be glad to give you a copy. Call him, or write Armstrong Machine Works, 8463 Maple Street, Three Rivers, Michigan.

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SPECIFICATION
and LAYOUT
for
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HEATING • VENTILATING
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COVER PHOTO: A long and costly study carried out by the affiliated companies of Standard Oil Company of New Jersey included observation of fumes and heat generated by torch cutting in this settler drum. Object: to establish **better ventilation techniques for work done in closely confined spaces.** Results: see our **Reference Section,** page 73, for a detailed report of this study. Its conclusions are neatly summarized in an alignment chart and illustrated tables.

HIGH SPOTS in this issue

BOILER ROOMS: **How to plan a boiler room layout** is the subject of our leading article, page 59. Prepared by two senior sales engineers of Cleaver-Brooks Co., it is a practical guide to finding optimum boiler room length, width and height, and for sizing the air supply and the vent stack. Supplementing this material is our **Detail Sheet,** page 89, showing details of a **typical boiler room layout** for two high pressure boilers and auxiliary equipment.

CENTRIFUGAL PUMPS: **Selecting centrifugal pumps for air conditioning applications** is the theme of the first of a series of four articles prepared by Henry Pollak. Starting on page 66, he discusses various characteristics of pumps—specific speed, drive speed, efficiency and suction conditions—and then relates these factors to the overall problem of pump selection.

SELECTING CONTROLS: The first step in **applying controls to double duct mixing units** is sound pre-design analysis, says Carlton Smallwood in introducing his article which appears on page 63. He illustrates the point by diagramming various control alternatives and then showing which is most appropriate to various areas of a typical office-building floor layout.

PLUMBING DESIGN: Mechanical systems for an aerospace medical research center are similar to those in a conventional group of research buildings except for the special equipment found only in such an establishment and the special wastes from that equipment. Author Larry Guss, on page 105, describes conventional and special equipment at the School of Aviation Medicine, Brooks Air Force Base, San Antonio, and gives **details of plumbing design for hot and cold water, compressed air, vacuum and waste systems.**

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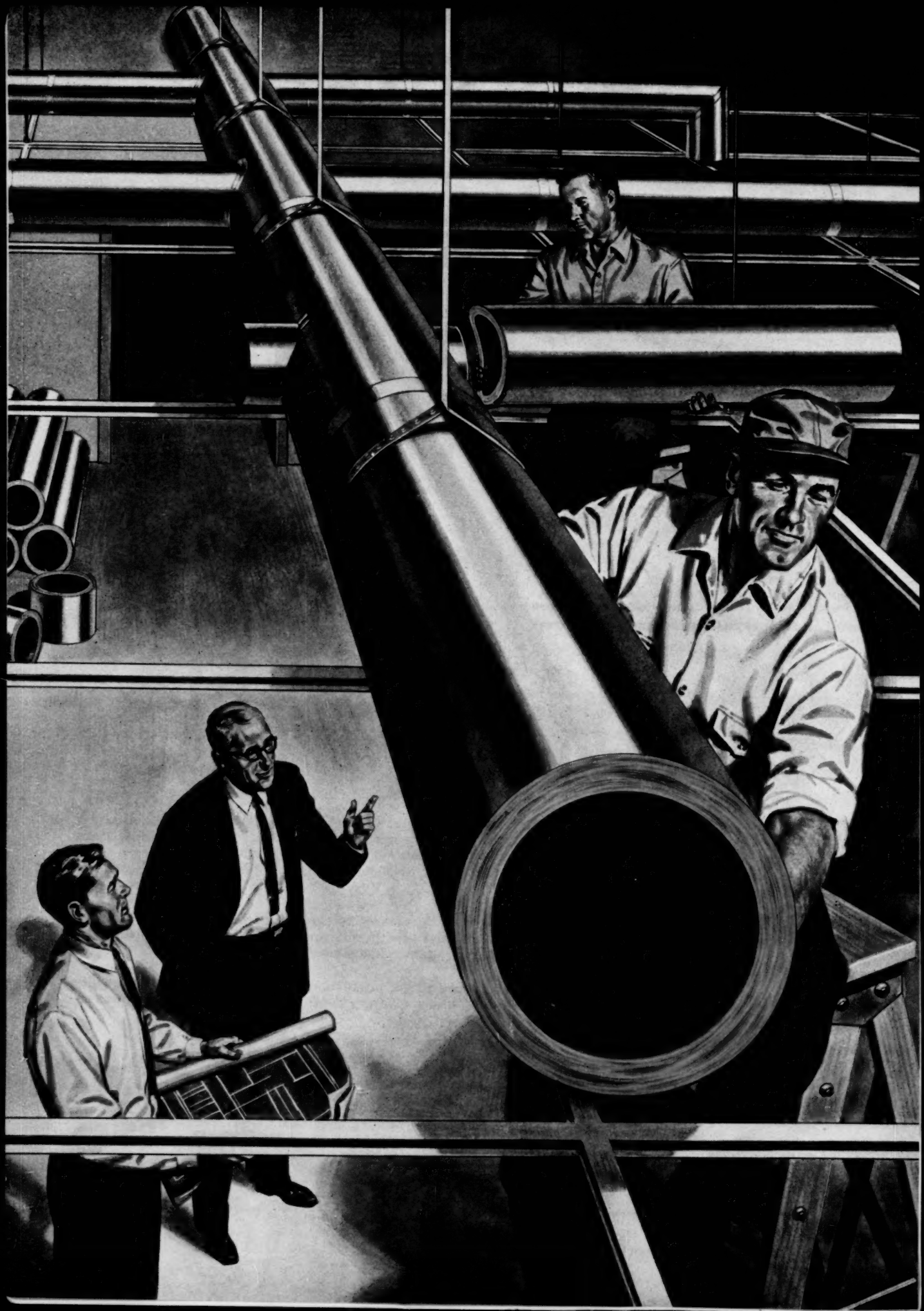

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What Readers Say:

Do Plenums Waste Power?

EDITOR
AIR CONDITIONING, HEATING & VENTILATING

This concerns the July installment of Mr. M. A. Ramsey's *Design Seminar.*

Regarding the material under the sub-head "Plenums Often Waste Power" on page 92, I believe the point raised is correct, but the solution given is not. It is my understanding that most, if not all, manufacturers of multiple-fan air conditioning units discourage the practice illustrated in Figure 8 for several reasons, including:

(1) Air velocity across the discharge of the individual fans is not uniform, and

(2) The air delivery of the individual fan is not always equal.

In addition to achieving the desired "equalizing" effect, the plenum permits simple construction and compactness. They can be used without appreciable pressure loss by providing diverging duct connections between the fan discharge and plenum. Where space is not available to maintain reasonable angle of divergence, diffusing vanes can be provided in these duct connections. The ducts at entrance to plenum usually are designed for a velocity of 1000 fpm or less to provide desired regain in static pressure and eliminate velocity effect within plenums. Diverging ducts with diffusing vanes within the plenum may prove most practical in certain cases. Obviously, the plenum is most important for systems with volume control in order to provide equal loading of fans, when flow to some of the sub-mains and branches is throttled.

J. W. Markert

Gibbs & Cox, Inc.

(Mr. Ramsey's reply appears on page 150)

Fig. 7

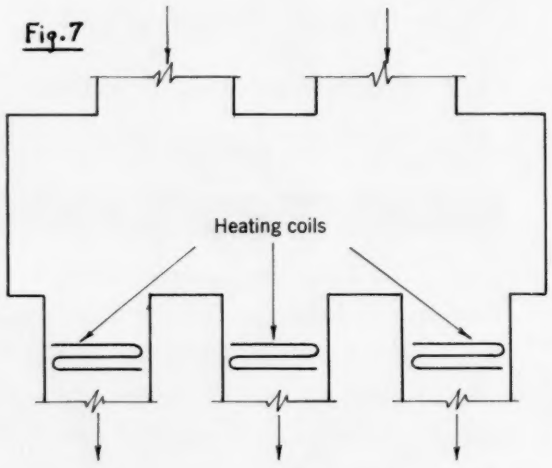
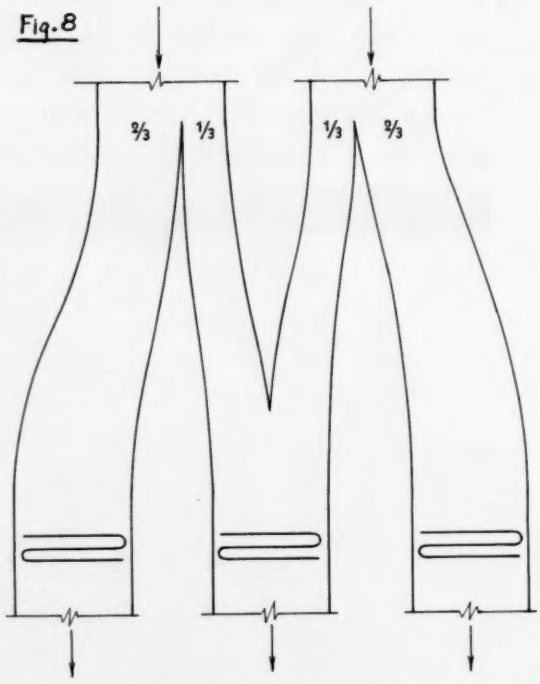
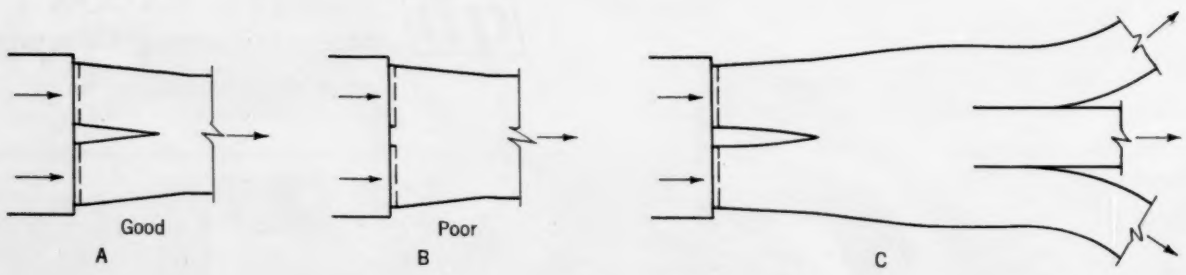


Fig. 8



Original Fig. 7 and 8 presented wrong and right way to connect two-fan conditioner with three ducts.



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NEWS OF THE MONTH

FRESH WATER FROM SEA IS STILL A COSTLY PROCESS

Unfounded claims of fantastically low costs for untried schemes has caused great confusion in the field of sea water conversion, according to Fred A. Loebel, president of Aqua-Chem, Inc., Waukesha, Wis.

Speaking before a group of scientists at the Desalination Research Conference at Woods Hole, Mass., Mr. Loebel outlined practical aspects of freshening saline water. He told scientists that not only chemistry, but dollars, should receive their attention.

The National Research Council invited Mr. Loebel to discuss brackish water conversion. He heads Aqua-Chem, which is associated with a Netherlands research firm that has developed an efficient method of removing salt ions from brackish water with electrodes and membranes. The Waukesha company, formerly Cleaver-Brooks Special Products, has been manufacturing saline water equipment for twenty years. The company has over 4,000 units currently in operation.

"Most of the literature and publicity so far has centered around sea water," Mr. Loebel said, "but in this country it seems likely that many brackish water conversion plants will be built before sea water conversion reaches consequential proportions.

Sea water averages about 35,000 parts salt per million of water; brackish water 1,000 to 4,000, with a greater variation in kinds of salt.

Loebel said that brackish water was a problem in the southwest, the north central region, along the gulf coast and the Atlantic coast of Florida and in the Canadian prairies. In these places, he said, conversion would be practical but solution of general water shortages of the nation would depend in the near future on reuse, recharging of ground aquifiers, correction of pollution and water conservation in general.

The most dependable, economic methods of freshening brackish water, he said, was electrodialysis for low salinity and vapor compression distillation in the higher ranges. He said that 70 cents per thousand gallons of water could be produced with favorable conditions. If natural water of fairly low salinity is available for dilution with the plant product, he foresaw an ultimate cost of about 35 cents.

"To this must be added some 20 cents for storage and distribution," he said. This total 55 cents cost, he added, compares with suburban rates of 33 cents to 70 cents in Milwaukee, Los Angeles and Oakland, Calif.; Norfolk, Va.; and Oklahoma City.

13TH CLEANER AIR WEEK BEGINS ON OCTOBER 22

For the seven days beginning October 22 to 28, millions of Americans will have their attention directed toward a National problem—air pollution—through observance of the Nation's 13th Annual Cleaner Air Week.

Sponsored by the Air Pollution Control Association, Pittsburgh, Pennsylvania, Cleaner Air Week is now an esablished autumn fixture in the National Promotional Calendar.

One of the Association's principal objectives in sponsoring Cleaner Air Week 13 years ago was to promote the public understanding and cooperation necessary in the community-wide approach to pollution control.

Tentative Technical, Educational Program For ARI Los Angeles Exposition Is Announced

A tentative program of educational and technical sessions in connection with the 12th Exposition of the Air-Conditioning, Heating and Refrigeration Industry, Los Angeles, Calif., February 11-15, 1962 was announced:

Sunday, February 11, 1:30 p.m. (Session No. 1), for service engineers:

"Evacuation of Refrigeration Systems Preparatory to Charging" .....
C. J. Otterholm, engineer, Richard S. Dawson Co.
"Maintaining Dry Refrigeration Systems" .....
W. H. Krack, sales manager, Sporlan Valve Co.
"Condenser Water Treatment" .....
Olivia Burkey, president, Chemical Solvents Co.
"Insulation of Piping Systems" .....
Vincent Cheap, engineer, Plant Rubber & Asbestos Corp.

Monday, February 12, 9 a.m. (Session No. 2), panel on Air-Conditioning Loads:

"Calculations and Considerations of Loads on Existing Buildings Installing Air Conditioning" .....
Cary B. Gamble, consulting engineer, New Orleans
"Solar Load"
C. S. Perkins, chief mechanical engineer, A. C. Martin & Assoc.
"Lighting Load" .....
Will S. Fisher, application lighting engineer, General Electric Co.
"New Residential Calculating Form" .....
H. T. Gilkey, technical secretary, NWAACA

(Continued on page 12)

And for Western Electric — A FUTURE OF FAULTLESS SERVICE

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TENTATIVE ARI LOS ANGELES PROGRAM—(CONTINUED)

Monday, February 12, 2 p.m. (Session No. 3), "business":

"Taxes" .....Speaker to be announced
"Credit" .....Hal Slane, manager, Plumbing and Heating Credit Service
"Salesmanship" .....Milton Wilson, sales manager, Recold Corp.

Monday, February 12, 2 p.m. (Session No. 4), for junior engineers:

"Equipment Vibration Control" .....To be announced
"Selection of 'V' Belt Drives" .....To be announced
"Selection of Electric Motors" .....
Symposium session by manufacturers' representatives

Monday, February 12, 7 p.m. (Session No. 5), Symposium:

"Heat Pumps" .....
D. V. Petrone, president, Typhoon Air Conditioning Div., Hupp Corp.
"Absorption Units" .....To be announced
Discussion Panel .....
I. C. McBryde, Southern Gas Co.; Dave Collins, Los Angeles Dept. of Water & Power; plus above speakers and several other participants.

Tuesday, February 13, 9 a.m. (Session No. 6):

"Hypothermia" (Use of Refrigeration as Anesthesia) .....
Dr. Lawrence H. Taylor, D.O.
"Air-Borne Bacteria Control for Operating Rooms" .....
Dr. Archie Solberg, Surface Combustion
"Climate Control for Schools" .....
Maurice J. Wilson, Educational Consultant, Carrier Corp.
(Discussion of pharmaceutical air-conditioning also tentatively planned)

Tuesday, February 13, 9 a.m. (Session No. 7), High and Medium Temperature Hot Water Heating, for heating contractors and engineers:

"Pumps—Selection and Other Problems" .....
Gilbert F. Carlson, engineer, Bell & Gossett Company
"Boilers" .....G. A. Rehm, chief engineer, Springfield Boiler Co.
"Controls" ....Edwin F. Snyder, Jr., Minneapolis-Honeywell Regulator Co.
(Also being considered: Paper on Piping System Design)

Tuesday, February 13, 2 p.m. (Session No. 8), Inter-Industry Relations—panel discussion:

Moderator .....Arthur J. Rendon, architect, Kistner, Wright & Wright
Contractor ..Richard B. English, executive vice-president, Murphy & Miller, , Representing RACCA
Consulting Engineer .....
Ralph M. Westcott, Holladay and Westcott, Consulting Engineers
Material Man .....William P. Tennity, William P. Tennity & Co.
(This panel is expected to cover such subjects as direct selling of equipment, free engineering by contractor representatives, loose use of "or equal" by engineers, competition with equipment sales by contractors, and similar subjects)

Wednesday, February 14, 10 a.m. (Session No. 9), for contractors

At this session, Henry B. Ely, Western Representative of RACCA, will lead a discussion on Bidding Practices, including bid depositories, bid registration, and bid moratoria, by a selected panel representing RACCA, MCA, Electrical Contractors, and the Allied Construction Industries of San Bernardino.

Wednesday, February 14, 2 p.m. (Session No. 10), High-Velocity Air-Conditioning, for air-conditioning contractors and engineers:

"High-Velocity Duct Work" .Louis Ray Hess, president, Pacific Air Products
"Attenuating Boxes" .J. W. Kreuttner, vice-president, Buensod-Stacy Corp.
"Conduit Systems" .....Robert Phillips, engineer, Carrier Corp.

Wednesday, February 14, 2 p.m. (Session No. 11), for refrigeration contractors and engineers:

"Low-Temperature Refrigeration" ....W. L. Holladay, Holladay & Westcott
"Defrosting Methods—Industrial Systems" .....Harold Halls, Recold Corp.
"Thermo-Electric Refrigeration" .....To be announced

2-DAY ENGINEERING INSTITUTE COVERS CONTRACTS, SPECS

The University of Wisconsin Extension Division in cooperation with Region 7 of the Construction Specification Institute will hold an Institute on Preparing Construction Contracts and Specifications on October 19 and 20, 1961, on the Madison campus of The University of Wisconsin.

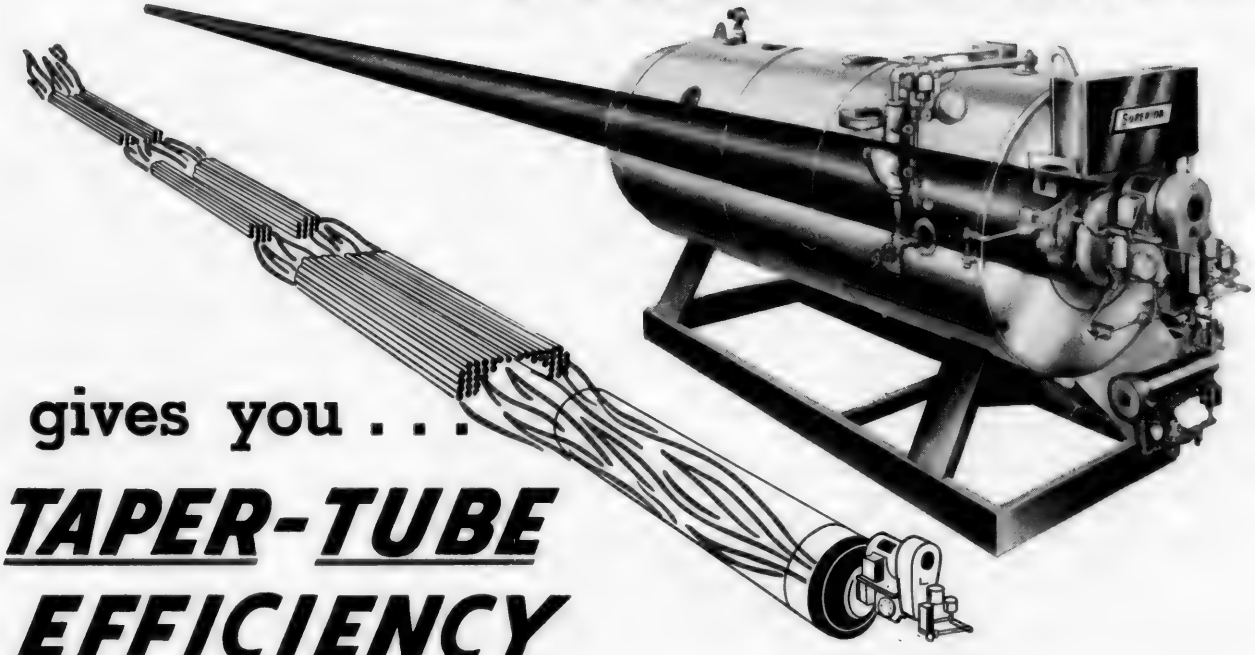
This Institute will be a two-day educational meeting in which current information on preparing contracts and specifications will be presented. It is offered in response to the needs of the construction industry to keep familiar with continually changing technology and conditions. It will be of interest to architects, engineers, material suppliers, contractors and others concerned with the preparation, use, interpretation or improvement of specifications and contract documents used in all phases of the construction industry.

Guest lecturers will be architects and engineers from all parts of the country, men tops in their fields. Topics to be covered include: (1) *Contract Documents*—AIA and CFC general conditions and mechanical and electrical requirements; (2) *Legal Principles as Applied to Construction*—legal principles of contracts, lein law, law of torts, what is a legal contract, contract documents as they apply to the Federal Government; (3) *Bidding Procedures* — bid forms, bid sheets, analyzing bids, unbalanced bids, advertisement, typical forms; (4) *Bonding of Bidders*—bid, performance and payment bonds, surety bond as a contract; (5) *Insurance for the Construction Industry* — law of agency, liability—property damage, architects and engineers liability, workmans compensation.

The meetings are informal in nature and restricted in size of attendance so that all who attend may have an opportunity to participate in discussion with the speakers and the other conferees

(Continued on page 137)

HOW SUPERIOR'S 4-PASS DESIGN...



gives you . . .

TAPER-TUBE EFFICIENCY

The long-lived efficiency of Superior Packaged Boilers results from fundamentals of design which are basically sound. Superior's 4-pass, down-draft design provides a minimum of 5 sq. ft. of heating surface for each unit of horsepower rating; **and every inch of that heating surface is effective.**

Why 4-PASS?

Theoretically (from the standpoint of heat transfer alone) the fire passes of a perfectly designed fire tube boiler would resemble a long, very gradually tapered cone surrounded by water. The large end would be sized in ratio to the volume and speed of the combustion gases so that the gases would be crowded into the tube and thus "scrub" the walls of the tube, forcing contact between fire and tube surface. As the gases give up their heat to the surrounding water (by transfer through the tube) the gases shrink in volume. The gradual taper of the tube compensates for this shrinkage, maintaining the scrubbing action which promotes efficient heat transfer.

Such a fire tube is impractical; but Superior's 4-pass design achieves the same effect. Its 4 passes are so designed that each successive pass has a lesser number of tubes (and hence a smaller area in cross section) for the passage of combustion gases. This is, in effect, **taper-tube** performance which results in the maximum practical efficiency of heat transfer . . . performance which makes it possible for Superior to guarantee **more** than 80% thermal efficiency **under field operating conditions.**

Superior Packaged Boilers are completely factory assembled, backed by undivided responsibility. Burn gas or oil, or both. Sizes from 20 to 600 b.h.p. for pressures up 250 p.s.i. or for hot water.

For condensed data describing the World's Most Complete Line of Packaged Boilers write today for Catalog S-19

Fire-Tube and Water-Tube PACKAGED BOILERS

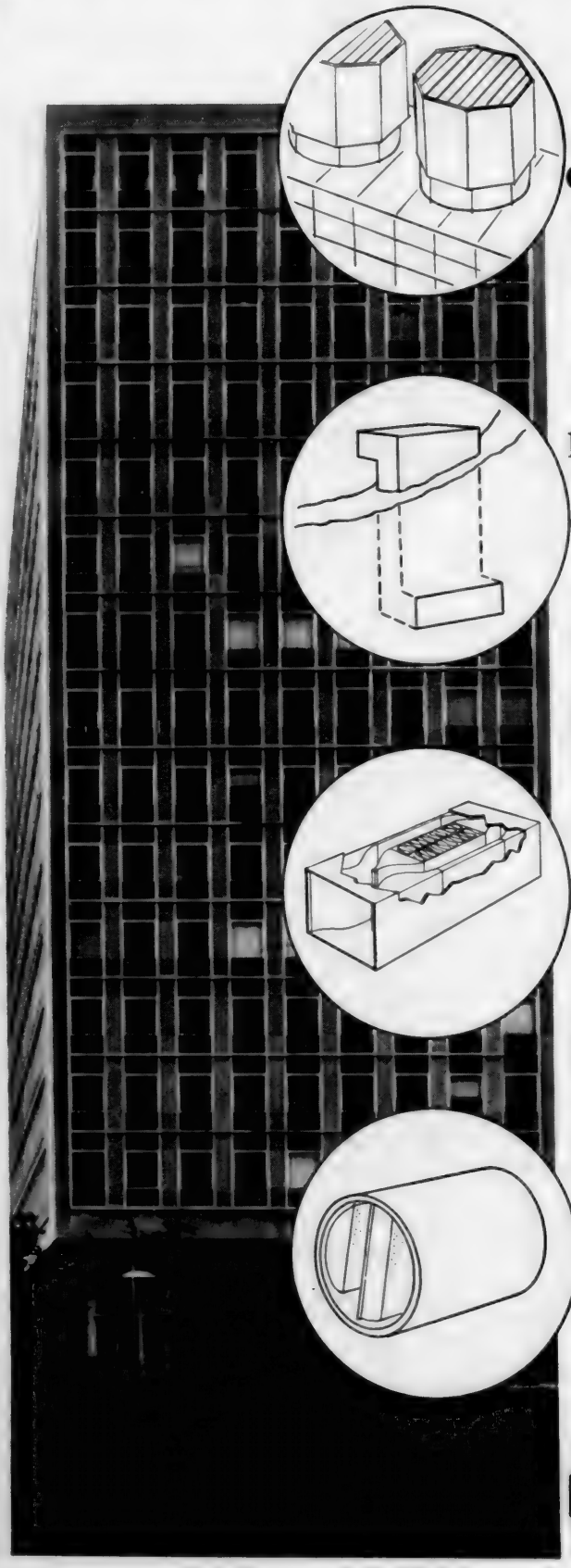
for STEAM or HOT WATER

SUPERIOR COMBUSTION INDUSTRIES INC.

TIMES TOWER, TIMES SQUARE, NEW YORK 36, N. Y.

SUPERIOR PACKAGED BOILERS

From basement to roof top...Aircoustat® silences noise



Cooling Tower Silencers

Water, fan and air noises are eliminated by Aircoustat Cooling Tower Silencers. Basic elements include intake sound proofing as well as exhaust mufflers. Because every building's requirements are special, every system is individually designed.

Return Air Vent Silencers

Block voices and other noises transmitted through transfer grills. Aircoustat Return Air Vent Silencers trap sound but not air. Available in three configurations and six stock sizes. Adaptable to a variety of installations—doors, walls, ceilings, etc.

Standard Duct Silencers

These low-cost, pre-engineered units assure a lifetime of trouble-free, maintenance-free service. Pre-determined values eliminate guesswork, *guarantee* the right attenuation. More than 60 stock models, fabricated in six lengths, available "off the shelf." No local job adjustments, no fabrication.

Circular Silencers

High velocity air system sounds need not be excessive if proper consideration is given to attenuation. An Aircoustat Circular Silencer adjacent to the fan does the job. Designed especially for higher pressure systems as well as for standard cylindrical ductwork. A full range of standard sizes available.

Selecting performance guaranteed AIRCOUSTAT *units is quick and accurate. We'll be pleased to supply you with complete technical and ordering information on any or all silencers in the line. Write:* KOPPERS COMPANY, INC., *2909 Scott Street, Baltimore 3, Maryland.*

KOPPERS®

SOUND CONTROL

Engineered Products Sold with Service

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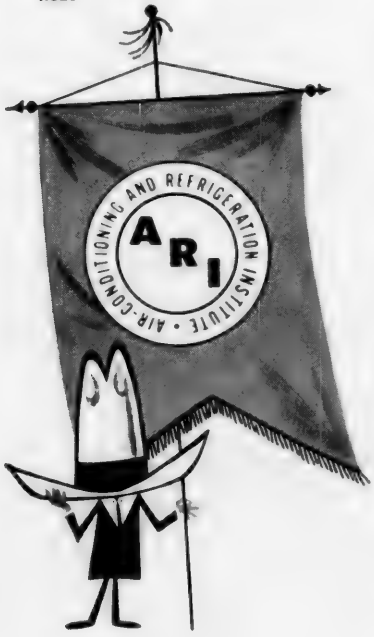


WE'LL ALL BE THERE
WILL YOU?

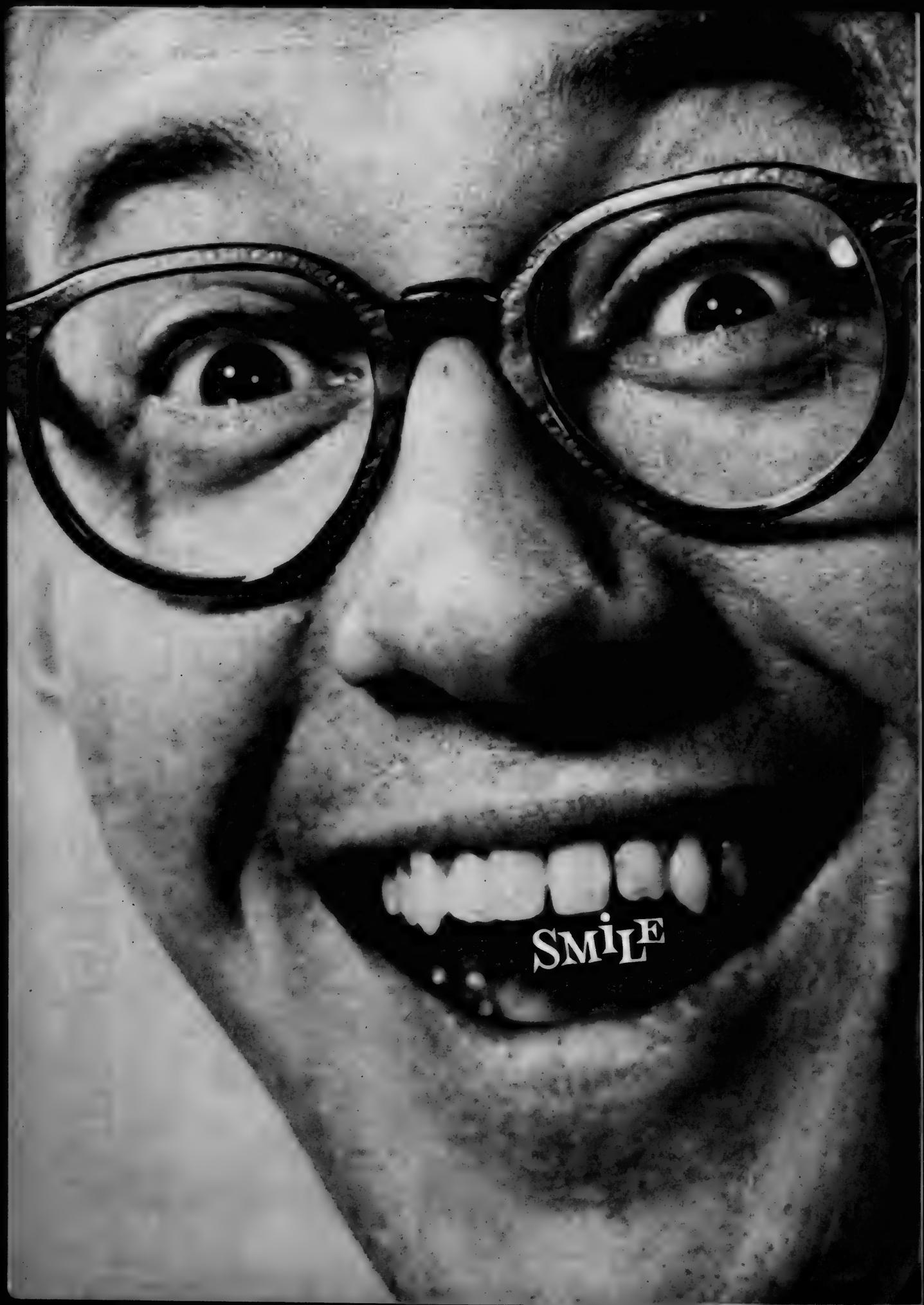
12TH NATIONAL EXPOSITION AIR-CONDITIONING, HEATING & REFRIGERATION INDUSTRY

LOS ANGELES • CALIFORNIA FEB. 12-15 • 1962

Here's the show you can't afford to miss—the biggest of all ARI Expositions. History-making opportunity to increase sales... talk to new sources of distribution... talk to manufacturers who can use your products... meet contractors and other specifiers ... establish and maintain your brand loyalty among service personnel... mingle with engineers in every phase of your industry.

This show already has a record number of national exhibitors. You owe it to your company's future in this great industry to exhibit; to yourself to attend in person. ARW, RACCA, RSES, ARI, NWAHACA, AND WACIA will all have a dominant place in this tremendous event. They'll all be there! Will You?

Plan to exhibit now! Contact: George E. Mills, Show Director
1346 Connecticut Avenue, N.W., Washington, D.C. • COlumbia 5-0405


SMILE

!

(of course, you will)

after discovering how

CARNES

NEW LOW-VELOCITY DUAL-DUCT ATC UNITS

SHRINK COSTS

SIMPLIFY DUCTWORK

MULTIPLY ZONES

INCREASE EFFICIENCY

CARNES is first to offer a completely packaged Low-Velocity Dual-Duct System, specifically designed for Low-Velocity. Units are backed by quality controlled production technique and accurately tested and rated for performance and sound power levels.

Dual-duct systems are recognized for giving the closest individual room temperature control, coupled with the quickest response to changes in heating and cooling loads. Here are just a few of the other advantages that will make you smile after specifying Carnes Low-Velocity Dual-Duct ATC (Acoustic Terminal Control) Units over other systems in your next project.

Advantages of a low-velocity dual-duct system over a high-velocity dual-duct system

To force the same quantity of air through the larger low-velocity ductwork requires less fan horsepower. This means a less costly fan, smaller horsepower motor, reduced electrical power. This is possible when space limitations do not require the smaller high-velocity ducts.

Low-velocity ductwork does not need to be leakproof. Slight leakage is often desirable to condition the space around the duct and to minimize or eliminate the need for thermal insulation. Sealing and welding of seams and joints are eliminated. Fittings need not be as precisely made to minimize noise and flow resistance, and lighter gauge material is approved.

With lower fan pressures and lower velocities, there is less system noise. The requirements for acoustical duct liner and package duct silencers are less.

Less expensive acoustic terminal control units are needed, because provision for self-attenuation is less involved. Constant volume devices are not required because the system static-pressure unbalance can be controlled by conventional methods.

Advantages of a low-velocity dual-duct system over a multizone system

More zones are permitted by the dual-duct system. In a multizone system, a separate duct must be run all the way from the multizone unit to each zone. In a dual-duct system the hot and cold mains or branches run the length and width of the floor and can be tapped off to a terminal control unit at each office or space in which selection of conditions is desired. This permits accommodating a greater number of zones for the same amount of available space for ductwork.

Advantages of a low-velocity system over a reheat system

In a reheat system, the cold supply air is maintained at a temperature to satisfy the room with the greatest cooling load. The reheat coils require year-round steam or hot water for heating or tempering all of the cold air. In a dual-duct system, only the air used for actually cooling the load or tempering the hot air need be cooled; thus, during the cooling season the hot coils need not be operated, because tempering is done by outside and recirculated air. In the dual-duct system, the coils are centrally located as opposed to requiring a separate coil at each zone — which multiplies the problems of cleaning and maintenance. The dual-duct system responds more quickly to load change because of the absence of individual coils.

Other methods

When compared to other methods of achieving individual room temperature control (such as induction-coil units, fan-coil units and self-contained window units) the dual-duct system is found to be less expensive, more quiet, requires no piping, and requires much less maintenance because the filters, fans and coils are centrally located rather than being contained in every individual unit. In power costs, life expectancy and maintenance costs, the all-air systems have the advantage over the others. The ability to change rapidly between heating and cooling is an advantage which an all-air dual-duct system has over wet-heat systems. The lack of residual coil heat to cause temperature override makes for quick compensation for solar loads. The quick response feature is of great importance in present day buildings with their vast expanses of glass.

Carnes Offers A Complete Range of Models and Sizes

2 Ceiling Models

End Discharge....5 sizes

Bottom Discharge....5 sizes

2 Window/Perimeter Models

Top Discharge.....2 sizes

Front Discharge.....2 sizes

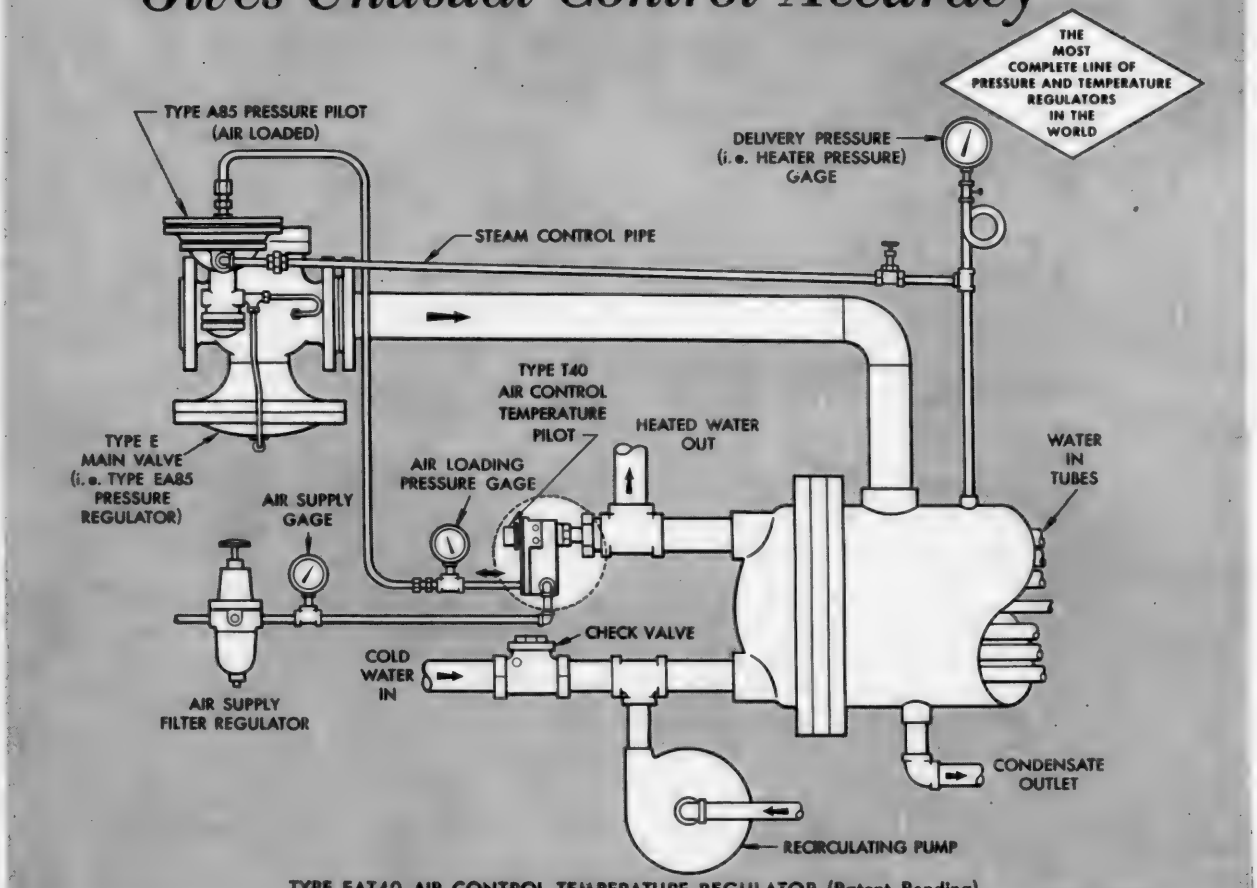
For full information on these Low-Velocity Dual-Duct ATC Units, write for Carnes Catalog No. 1361.

CARNES

LEADERS GO TO CARNES FOR THE NEWEST IN AIR DISTRIBUTION

CARNES CORPORATION, VERONA, WISCONSIN / CANADIAN SUBSIDIARY: WEHR AIR EQUIPMENT COMPANY, LTD., 86 GERTIE STREET, WINNIPEG 2, CANADA

New Spence Temperature Control System Gives Unusual Control Accuracy


THE MOST COMPLETE LINE OF PRESSURE AND TEMPERATURE REGULATORS IN THE WORLD
TYPE A85 PRESSURE PILOT (AIR LOADED)
DELIVERY PRESSURE (i.e. HEATER PRESSURE) GAGE
STEAM CONTROL PIPE
TYPE T40 AIR CONTROL TEMPERATURE PILOT
HEATED WATER OUT
WATER IN TUBES
TYPE E MAIN VALVE (i.e. TYPE EA85 PRESSURE REGULATOR)
AIR LOADING PRESSURE GAGE
AIR SUPPLY GAGE
CHECK VALVE
COLD WATER IN
AIR SUPPLY FILTER REGULATOR
CONDENSATE OUTLET
RECIRCULATING PUMP

TYPE EAT40 AIR-CONTROL TEMPERATURE REGULATOR (Patent Pending)

In a recent installation the new Spence air-control temperature regulating system provided:

- ±5°F control accuracy under wide and instantaneous load swings of 210 to 80 gallons per minute.
- Up to 50% reduction in cost as compared to instrument systems of similar accuracy.

This unique cascade-type control with throttling range adjustment independent of maximum heater pressure was developed to meet today's demand for greater control accuracy.

Additional features of the new Spence Temperature Control System include:

- 200°F wide adjustable temperature range
- Adjustable speed of steam pressure change
- Over and under temperature protection
- Pressure limit control
- Fast response
- Very low air consumption
- Field reversible for heating or cooling

The Spence Type EAT Air Control Temperature System, when properly installed, will tame wide ranging, fast changing loads of instantaneous heaters and modern heat exchangers. The cascade principle plus the use of an extremely fast responding bi-metal temperature sensing element reduce time lags and provide control stability.

Here's how the new Spence system operates:

Quick response is based on a bi-metal temperature sensing element. Temperature pilot continuously regulates a loading air pressure.

This loading signal, when applied to a pressure regulator to reflect heater temperatures, causes it to adjust the main valve as changes in load require.

Spence has also developed a new pressure control system based on this same cascade principle. This system has a control accuracy of ½ psi or better from positive pressures through the vacuum range to 30" Hg.

For complete information on these new air controlled temperature and pressure control systems, write for your copy of Bulletin 9.

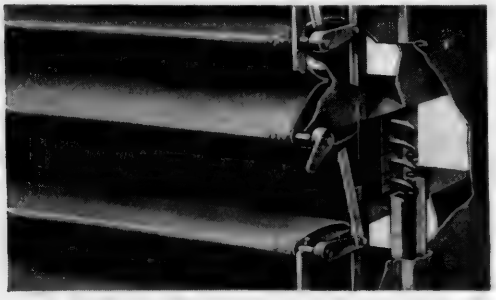
SPENCE ENGINEERING COMPANY, INC.
Walden 1, New York
SE-140

NEW WING *IFB HEATER SECTIONS

for freeze proof air conditioning, preheating and tempering applications

*Integral Face By-Pass

Steam, hot water or high temperature hot water operated Wing *IFB Heater Sections permit simple, low cost, freeze proof installations in any central air conditioning system. Temperatures, controlled without throttling steam are uniformly maintained. Modulating steam valves or multiple coils are not required. Non-stratified air delivered three feet downstream of section eliminates need for extensive duct work normally required for mixing purposes. Thermostat sensing bulb location problems are simplified. Wide range of sizes up to 35,000 CFM, 24 sq. ft. of face areas from single section.



Constant Pressure "Air-flow-Line Dampers"

The V-type "Air-flow-Line" dampers maintain a constant pressure drop across the *IFB Heater Section regardless of damper position. Constant air flow resistance is maintained. Fan horsepower requirements can be held to a minimum.

WC 103

WRITE FOR BULLETIN IFB-61

WING

L. J. WING MFG. CO.
DIVISION OF AERO-FLOW DYNAMICS, INC.
158 VREELAND MILLS ROAD, LINDEN, NEW JERSEY
FACTORIES: LINDEN, N.J. AND MONTREAL, CANADA

"Here's why I standardized on H&M cooling towers

...they're the only towers with a 20-Year Guarantee on the wetted deck surface!

"In my town, most air conditioning and refrigeration buyers prefer cooling towers for their installations. But local water conditions are pretty hard on the fill. Fungus and algae grow fast and furious—so fast that the accumulation actually blocks air flow and cuts tower capacity!

"After trying several makes, I standardized on H&M Cooling Towers. *The wood fill is specially treated with creosote applied under pressure,* and water plants and animals can't live on that! That's why the Halstead & Mitchell towers carry a 20-Year Guarantee on the wetted deck against failure due to fungus attack or rotting."

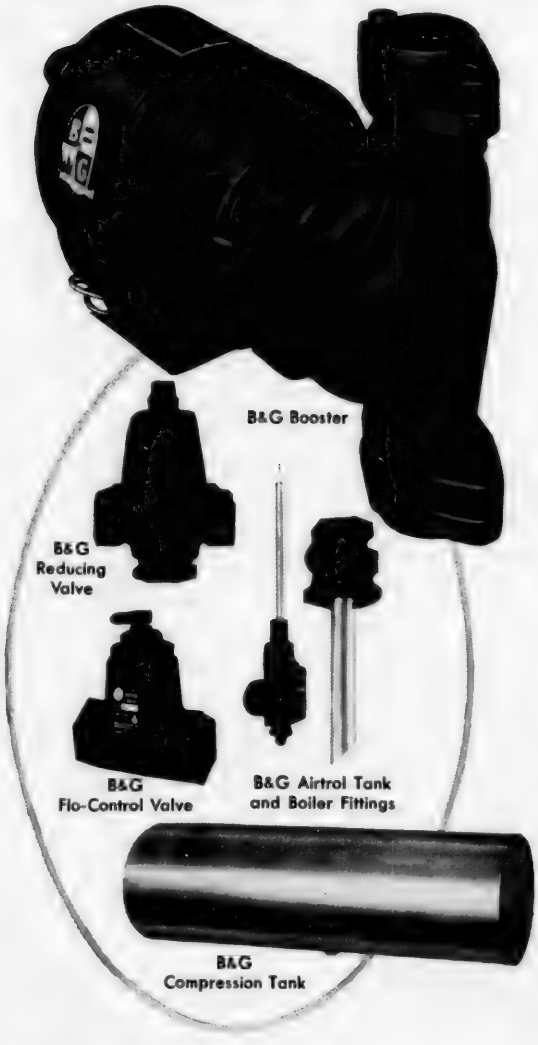
If you want towers that will last, and need a minimum of care, you should find out about H&M towers. Call your local parts wholesaler or write for Bulletin EC-500 (Propeller Fan Towers, 3 to 150 tons) or Bulletin ECKB-601 (Centrifugal Fan Towers, 5 to 100 tons). Halstead & Mitchell Co., Dept. B-9 Bessemer Building, Pittsburgh 22, Pa.

HM

Halstead & Mitchell

Cooling Towers • Air-Cooled Condensers • Air Handlers and Coils • Water-Cooled Condensers
Export Representatives: Sabal-Kielman, Inc., 15 William St., New York 5, N. Y.

Architects: Sargent-Webster-Crenshaw & Folley **General Contractor:** Joseph E. Bennett Co., Inc. **Plumbing, Heating & Ventilating Contractor:** Northern Mechanicals, Inc.



NINE B&G® BOOSTER PUMPS PROVIDE CONTROLLED COMFORT IN ST. LAWRENCE SEAWAY CORPORATION'S ADMINISTRATION BUILDING, Massena, N.Y.

The forced circulation hot water equipment in this outstanding office building is made by B&G... Booster Pumps, Flo-Control Valves, Airtrol Systems and Reducing Valves.

The building is divided into nine zones for better temperature control, with each zone served by a B&G Booster. A bronze Booster is used for circulating domestic hot water.

Over 3,500,000 Boosters are in service today...clinching evidence that their superior quality and performance has never been challenged. The reasons why they so completely dominate their field are not hard to find. Above all they are *quiet—vibrationless*...the prime essentials of a forced hot water circulating pump. They are dependable and profitable —not a cause of endless service and customer dissatisfaction. Sound design and sturdy construction of best materials assure efficient performance for years.

B&G *Hydro-Flo* Products are made by a company which offers help in any problem of design or installation—and with nation-wide distributors and service organizations.

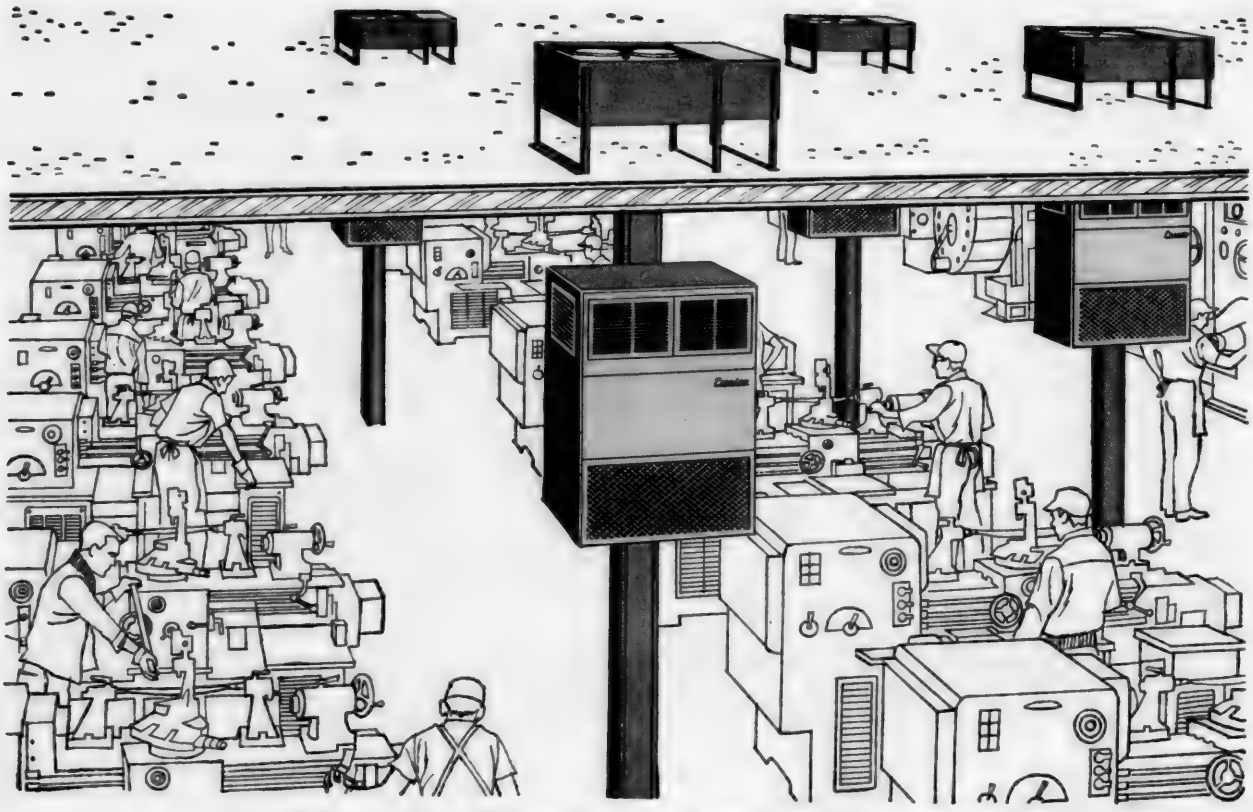
Hydro-Flo® SYSTEM

BELL & GOSSETT

COMPANY

Dept. GU-4, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario



Typical installation: Outdoor sections on the roof; indoor sections hung on columns.

New Carrier Heat Pump Weathermakers are practical even in colder climates

If you are planning or specifying the heating system for a new plant, or replacing a plant's heating system, the Carrier Heat Pump Weathermaker* is well worth considering as an investment that can save your client money. It is no longer true that climate is a deterrent to choosing a heat pump. The improved designs of these all-electric Weathermakers combined with the heat load from concentrations of light, machinery and people in industrial applications now make it possible to operate heat pumps as economically in colder climates as many types of conventional systems.

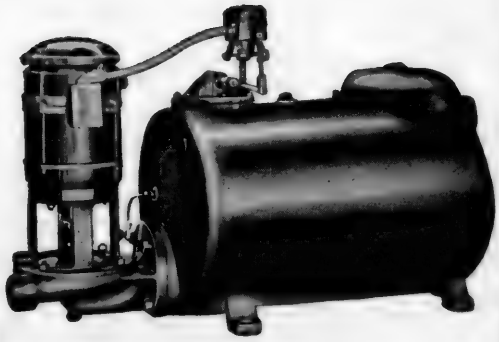
Besides operating economies, these heat pumps are space savers, too. The indoor sections of these versatile Carrier units may be suspended from the ceiling, hung on the walls, or they may stand on the floor. The arrangement shown above is for a one-story plant of about 30,000 square feet. The indoor sections are hung on columns to allow the freedom of four-way air discharge; the outdoor sections are installed on the roof. Other arrangements can be tailored to your own particular requirements.

There are other dividends as well. Because it is all electric, soot, smoke, flame, fuel lines and storage tanks are eliminated from the heating system. Because it is also air-cooled, it requires no plumbing, water, or water towers. Because it is a one-system heating-and-cooling package, maintenance costs are cut. Fewer moving parts mean less servicing. And because a Carrier Heat Pump Weathermaker operates year-round, the normal expense resulting from seasonal startups and shutdowns is eliminated entirely.

Carrier manufactures a complete series of packaged heat pumps in addition to other air conditioning equipment. You can depend on your Carrier representative to make an impartial recommendation best suited for the job. Call him . . . he's listed in the Yellow Pages. Or write Carrier Air Conditioning Company, Syracuse 1, N. Y.

*Reg. U.S. Pat. Off.

Carrier Air Conditioning Company



SKIDMORE
TYPE "VC" PUMP

TYPE "VC" PUMP

Always a favorite for smooth dependable operation . . .

NOW!

THE NEW SKIDMORE "VCS" PUMP

Featuring mechanical shaft-seal and close-coupled design . . .

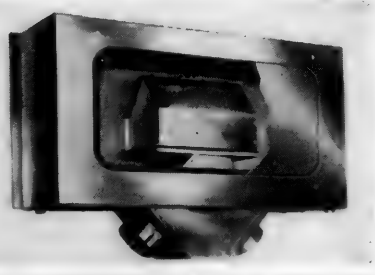
Write today for Bulletin No. 10-C

SKIDMORE CORPORATION • ST. JOSEPH, MICHIGAN

1,394 windows in the roof

This is the "doghouse" in every Dual Duct air mixing unit. Quietly and efficiently, its 1,394 window-like apertures are opened and closed automatically to maintain constant air volume regardless of static pressure variance. That means there's never a balancing problem, never a drop-off or sudden air blast resulting from activity or shut-down in other zones.

For new structure or modernization, Buensod Dual-Duct is the perfect year-'round air conditioning system . . . completely compatible with existing radiation, too.



Buensod-Stacey Type V, Under-Window Dual Duct air mixing unit.

BUENSOD-STACEY CORP. • MANUFACTURED PRODUCTS DIVISION

BUENSOD-STACEY

45 West 18th Street • New York 11, N. Y. • Subsidiary of Aeronca Manufacturing Corporation

dpa

HORIZONTAL SPLIT CASE—DOUBLE SUCTION, SINGLE STAGE PACKED PUMP

Capacities to 2800 GPM

Heads to 290 Feet

Discharge Sizes 1½ to 8 inches inclusive

Temperatures to 250° F.

A NEW, QUIET, VIBRATIONLESS PUMP

The new Chicago DPA pump is an exceedingly sturdy, quiet unit providing maximum hydraulic efficiency at all times. Suction, discharge openings and bearing housings are integrally cast into the lower case for maximum rigidity and perfect alignment.

Positive impeller positioning is assured at all times due to a novel and proven design of the rotating assembly. Removal of the entire rotating assembly for inspection is made easy and exact re-alignment assured.

The cast bronze impeller is hydraulically and dynamically balanced and the water passageways hand ground for smooth vibrationless operation. The extra deep stuffing boxes are tapped and bronze lantern rings provided for connection of water sealing.

For further information contact your local Chicago Pump Distributor or write direct for Bulletin 102-A.

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fmc
FOOD MACHINERY AND CHEMICAL CORPORATION

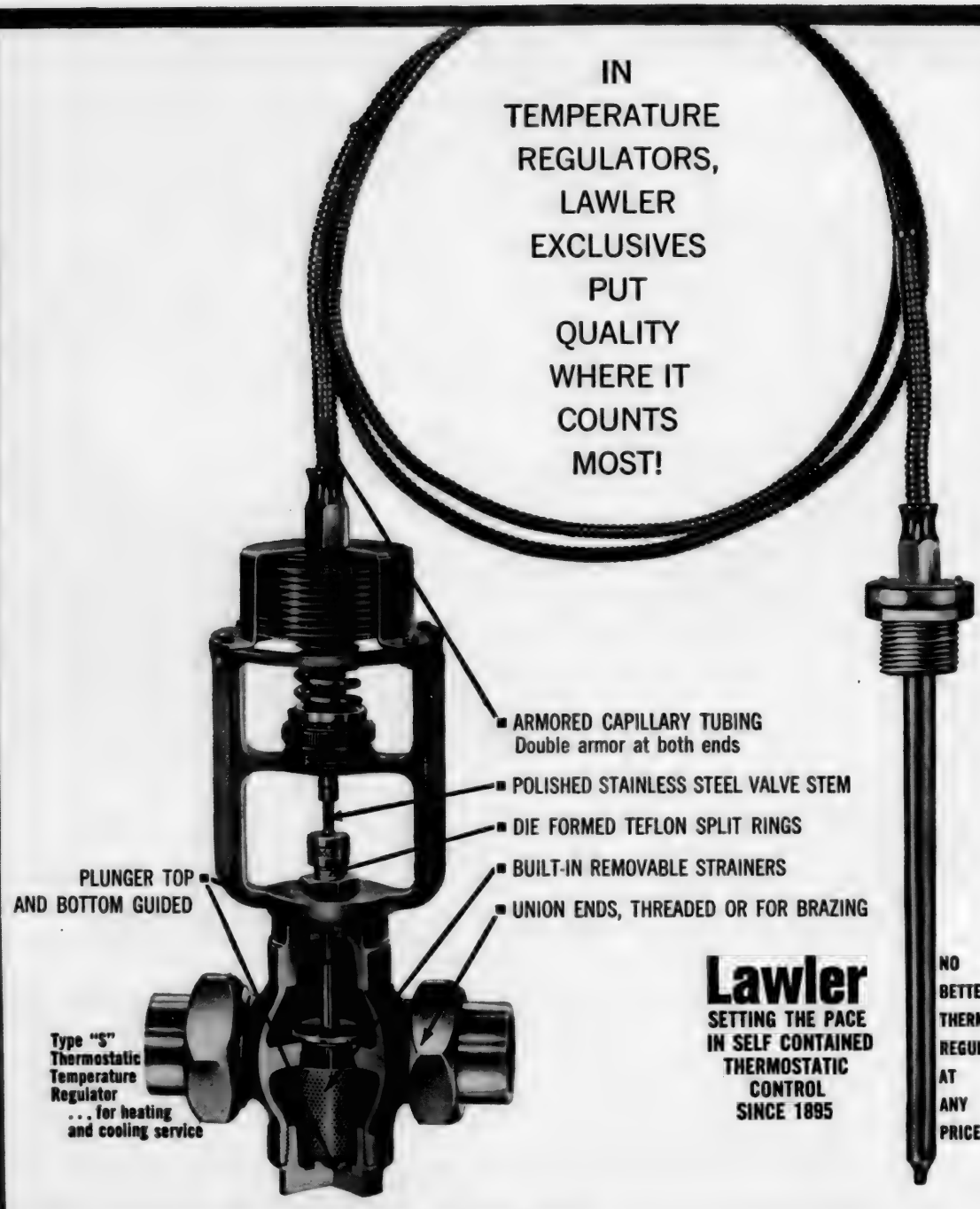
Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION
HYDRODYNAMICS DIVISION

CHICAGO PUMP

622J DIVERSEY PARKWAY • CHICAGO, 14, ILLINOIS

IN TEMPERATURE REGULATORS, LAWLER EXCLUSIVES PUT QUALITY WHERE IT COUNTS MOST!



- ARMORED CAPILLARY TUBING
  Double armor at both ends
- POLISHED STAINLESS STEEL VALVE STEM
- DIE FORMED TEFLON SPLIT RINGS
- BUILT-IN REMOVABLE STRAINERS
- UNION ENDS, THREADED OR FOR BRAZING

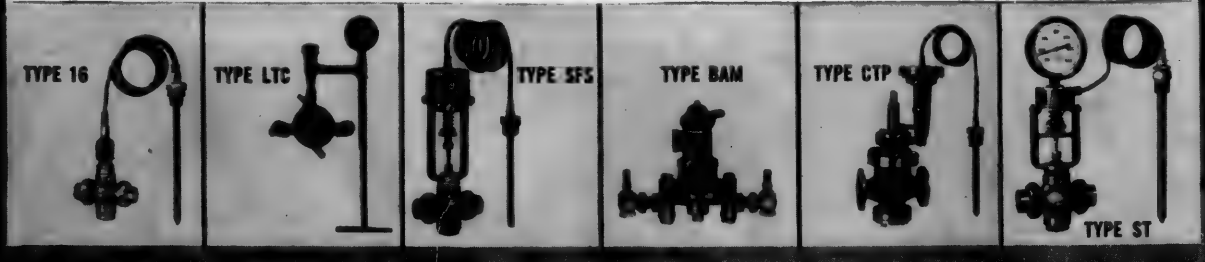
PLUNGER TOP AND BOTTOM GUIDED

Type "S" Thermostatic Temperature Regulator . . . for heating and cooling service

Lawler
SETTING THE PACE IN SELF CONTAINED THERMOSTATIC CONTROL SINCE 1895

NO BETTER THERMOSTATIC REGULATOR AT ANY PRICE

SELF-CONTAINED CONTROL VALVES FOR EVERY APPLICATION



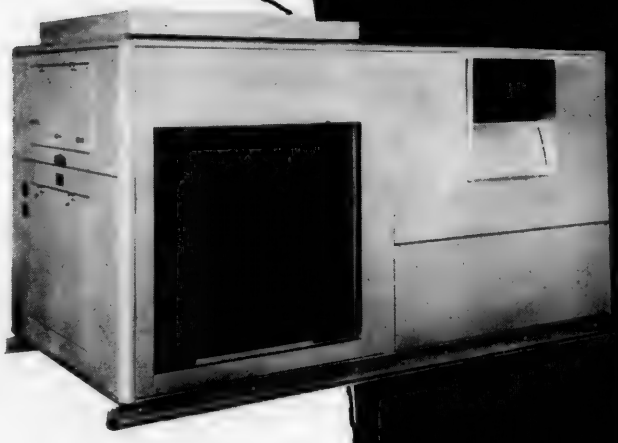
Lawler AUTOMATIC CONTROLS, INC., MOUNT VERNON, N.Y.

Governair

COMPLETELY SELF-CONTAINED

AIR COOLED

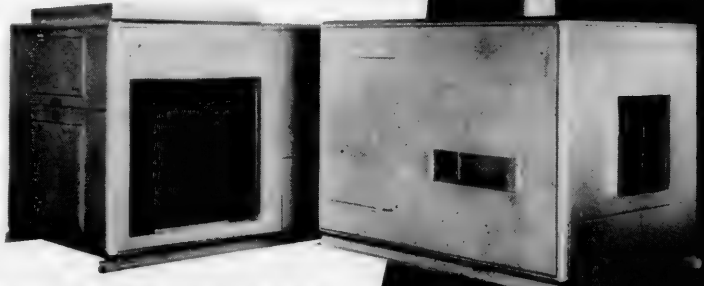
PACKAGE UNIT TYPE SCAC



GOVERNAIR'S SCAC is available in six basic models from 10 through 40 ton capacities. Typical GOVERNAIR flexibility has been maintained with a choice of 4, 5, or 6 row cooling coils offered to meet all capacity requirements. Roof mounting has been considered in the Low-Silhouette arrangement.

The basic one-piece cooling unit is housed in a rugged weatherized cabinet and mounted on rails. It is completely wired, charged and tested at the factory. Demountable and remote arrangements are available, and accessories include choice of filters, face and by-pass dampers, reduced voltage starters, Low Ambient Control, and the Gas Fired Furnace Section.

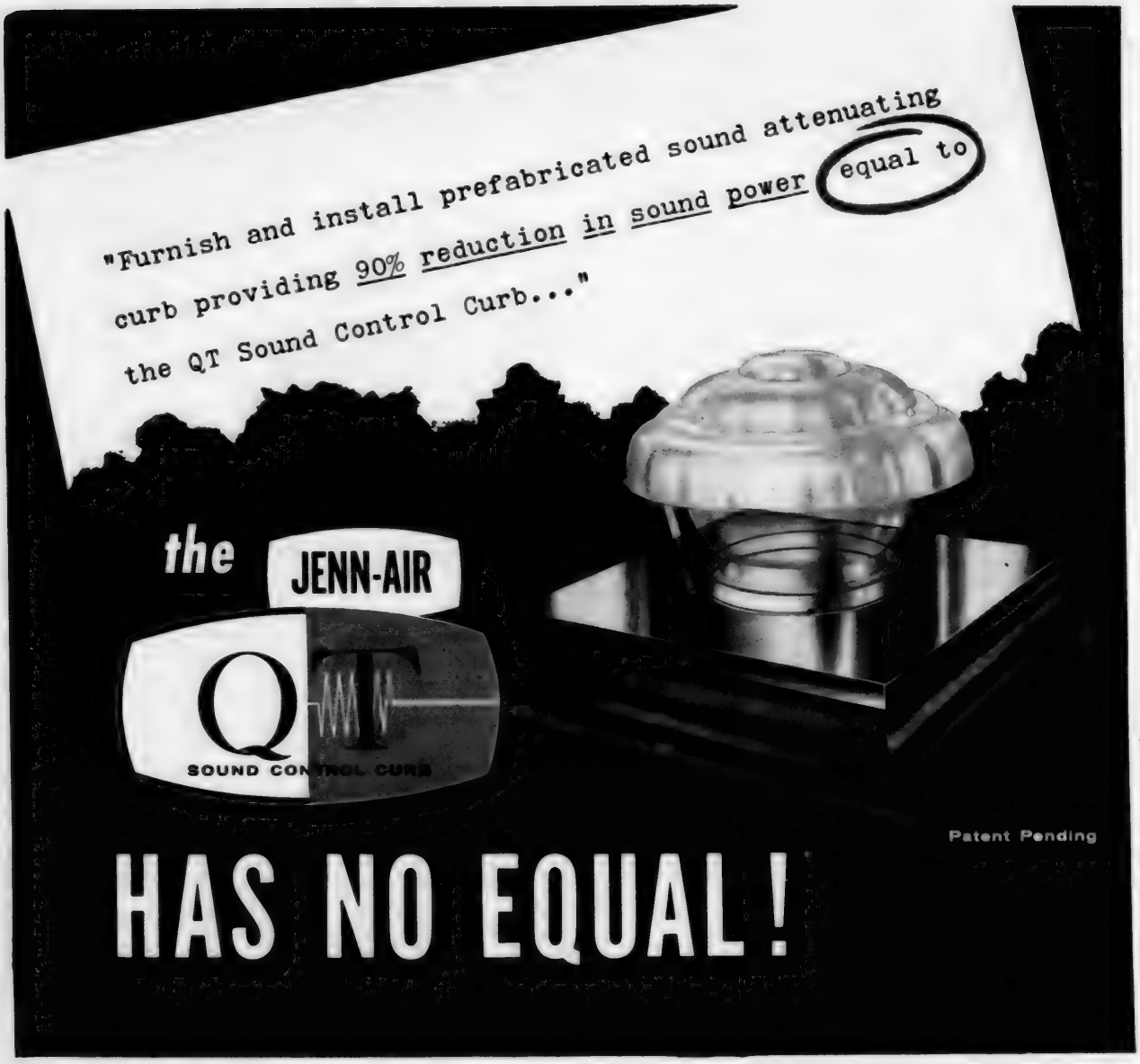
YEAR-'ROUND AIR CONDITIONING is accomplished by the use of the gas-fired furnace section. This accessory consists of a complete and unaltered gas-fired duct furnace housed in a Weatherized Cabinet with an integral by-pass damper arrangement. Refrigerated air may completely by-pass the furnace, while any desired amount of air is diverted through the furnace during the heating cycle.



FOR AN INFORMATIVE FOLDER, CONTACT YOUR LOCAL GOVERNAIR REPRESENTATIVE OR WRITE

GOVERNAIR

"Furnish and install prefabricated sound attenuating curb providing 90% reduction in sound power equal to the QT Sound Control Curb..."



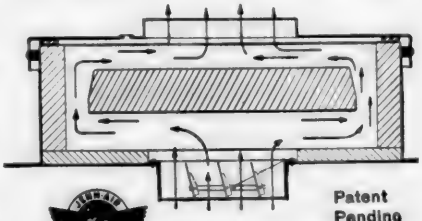
HAS NO EQUAL!

Only Jenn-Air's QT Sound Control Curb absorbs 90% of the exhauster's sound power at inlet—a performance rating verified by independent laboratory tests. This is equivalent to the attenuation of 18 feet of 14" square duct lined with one inch of glass fiber (6# density).

Jenn-Air's QT Curb achieves whisper-quiet ventilation without sacrificing air moving capacity. Air delivery is only 10% less (including damper loss) than through a conventional curb.

Get *all the facts* before you specify —you'll find that the QT Sound Control Curb *has no equal* when it comes to effective noise suppression of power roof exhausters. Write for Bulletin 601-SC.

EXCLUSIVE JENN-AIR DESIGN
Cross Section QT Sound Control Curb



JENN-AIR

JENN-AIR leads in functional imagineering

JENN-AIR PRODUCTS COMPANY, INC., 1102 STADIUM DRIVE, INDIANAPOLIS 7, INDIANA

WHERE NOISE IS A NUISANCE SPECIFY RAY BOILERS

INSULATED FOR QUIET OPERATION

Noise is a problem of great importance in such locations as schools, hospitals, research laboratories, churches, office buildings and theaters. To help combat this problem, Ray engineers have paid particular attention to the reduction of operating noise in Ray Packaged Boilers.

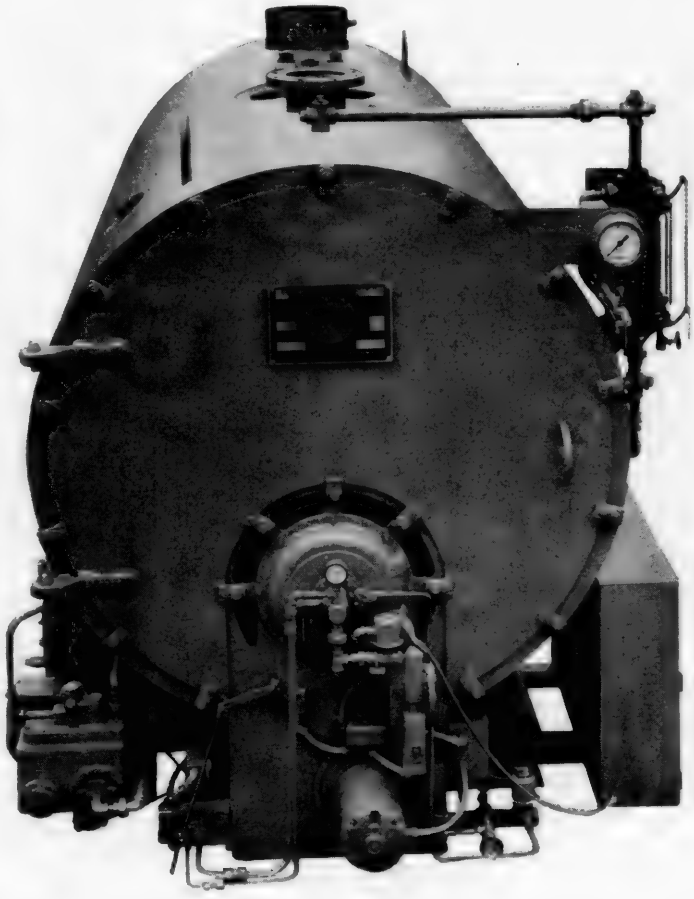
To effectively silence the sound of rushing combustion air and fan noises, the air is drawn through a specially designed labyrinth of acoustically treated sound-absorbing passages within the windbox. Other Ray low noise features include heavy, vibration-free construction, quiet, low horsepower motors, and large, dynamically and statically balanced fans. In dual gas-oil units, the compressor motor is automatically switched off during gas operation. Ray Boilers provide finger switch selection of gas or oil firing, and require a minimum of supervision, due to electronically controlled, fully automatic operation.

From the world's first horizontal rotary oil burner, introduced by Ray, to the latest in Packaged Boiler systems, Ray's 89 years of experience guarantees you the most reliable products available in the field of combustion equipment.

Ray Packaged Boilers are sold and serviced by one of the most complete dealer organizations in the world. You'll find your Ray Dealer in the Yellow Pages of your 'phone book.

CHOSEN FOR RELIABLE, AUTOMATIC OPERATION...

This 60 h.p. Series E Ray Packaged Boiler (see illustration) is being installed in the Farm Dryer Experimental Laboratory, Agriculture Division, Oregon State University, Corvallis, Oregon.



LEADERS IN THE FIELD OF COMBUSTION EQUIPMENT SINCE 1872

THE BOILER WITH AN INTERNATIONAL REPUTATION

RAY

RAY BURNER CO.
BOILER DIVISION
1301 SAN JOSE AVENUE
SAN FRANCISCO, CALIFORNIA
4024 FILBERT STREET
PHILADELPHIA 4, PENNSYLVANIA

FIRST PRE-PACKAGED

electric storage water heater for commercial, industrial and institutional use.

The new P-KW is the first electric storage water heater to be offered as a standard package unit. It is shipped fully wired, insulated and factory tested. It requires only electrical and water connections to place in operation.

The new unit is equipped with immersion heater, control thermostat, magnetic contactors, circuit breaker, panel control box, ASME temperature and pressure relief valves, thermometer, pressure gauge, metal jacketed insulation, and integral support skids.

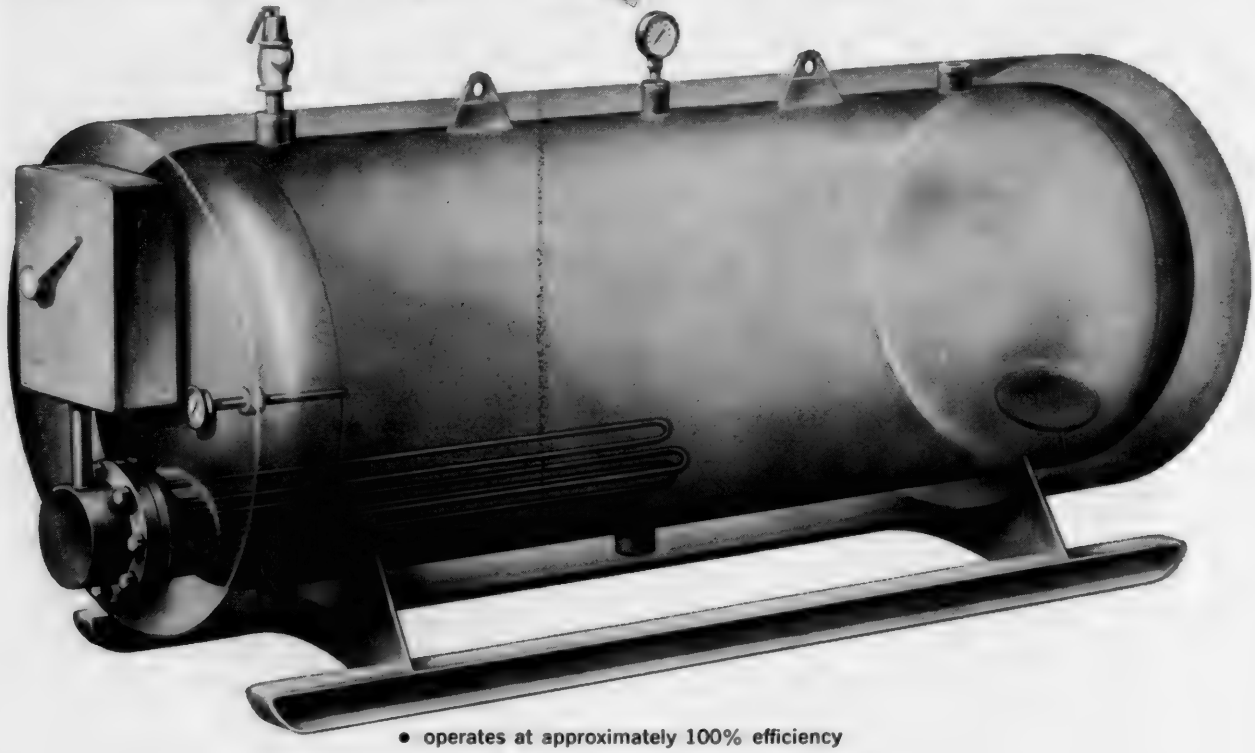
Made by P-K on a custom basis for many years, P-KW Electric Storage Water Heaters are designed and fabricated in accordance with the ASME Code and Federal, State and local regulations.

Components that comprise the electrical system, including wiring, meet the requirements of Nema standards and the National Electrical Code.

The immersion heating elements are operated approximately 10 per cent below their voltage capacity—assuring long, trouble-free service. The thermal conversion approximates 100 per cent efficiency.

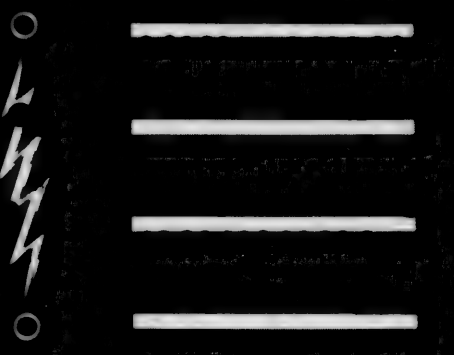
Pre-packaged P-KW water heaters can be selected for three working pressures – 100, 125, and 150 psi.

WRITE FOR CATALOG NO. P-KW-1: contains diagrams, specifications, complete engineering and performance data. Address your request to: The Patterson-Kelley Co., Inc., 92 Morgan Avenue, East Stroudsburg, Pa.



- operates at approximately 100% efficiency
- storage capacities from 284 to 1,300 gallons
- recovery capacities from 41 to 410 gph
- horizontal or vertical design
- safe, silent, automatic

Patterson Kelley



Polaroid keeps picture rolls dust-free with PRECIPITRON electronic air cleaning

The Polaroid® Land camera develops its own pictures when the user pulls the film between two rollers. This spreads developing fluid between positive and negative sheets. If dust got into the negative roll during manufacture, it could spot or streak the print at the time of developing.

Polaroid eliminates this hazard by keeping its film manufacturing plants dust-free with PRECIPITRON® electronic air cleaners. These units trap the minute particles of dirt--less than 1 micron in size --that pass right through ordinary mechanical filters. The film is protected from all sizes of airborne dirt down to 1/100 micron.

You can rid your plant of airborne contamination...reduce product rejects...cut housekeeping costs...with PRECIPITRON electronic air cleaners.

They're cheaper to own and maintain than mechanical filters, yet much more efficient. Ask your consulting engineer, or call in Sturtevant application engineers. You can be sure...if it's Westinghouse.

J-80727

WESTINGHOUSE ELECTRIC CORPORATION
Sturtevant Division, Dept. IV-27
Hyde Park, Boston 36, Mass.

Send me your Precipitron brochure.

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TITLE_____

COMPANY_____

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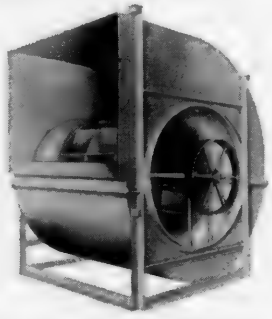
® — REGISTERED TRADEMARKS

Westinghouse **Sturtevant Division**

Feather-floating zephyr to tropical hurricane velocity . . . you name it, and specially controlled Peerless Air Moving Equipment provides it on cue. All-welded construction keeps housing and scroll firm and quiet. Obstruction-free inlets allow air to pass through the unit at unimpeded peak efficiency. Welded wheels are statically and dynamically balanced for perfect rotation. Engineers! You can specify Peerless with confidence. Contractors! You can install Peerless with ease and assurance. Users reap the benefits of quiet, dependable, inconspicuous service.

Investigate Peerless Air Moving Equipment Today! Write to Peerless Electric Division, H. K. Porter Company, Inc., 1400 West Market St., Warren, Ohio.

Manufactured and sold in the western states by Master Fan Corporation, H. K. Porter Company, Inc., 1323 Channing Street, Los Angeles 21, California. NOW AVAILABLE—Centrifugal Blowers to 132″ wheel diameter, Turbo Blowers to 55″ S. P., Tube and Vaneaxial Blowers and Industrial Fans to 104″ wheel diameter.



PORTER **PEERLESS ELECTRIC DIVISION**
H. K. PORTER COMPANY, INC.

Member—Air Moving and Conditioning Association, Inc.

Roommate II®

dramatic new concept in year-round air conditioners

the company behind the product—

A. Good, Edwards has been for many years a basic manufacturer of heat transfer components and equipment for residential, commercial and industrial use. We have gained a reputation for leadership in developing new systems and equipment —

Q. For instance?

A. Let's take Zone Control which Edwards pioneered. Zone heating, properly engineered, will save the end — user up to 30% in fuel costs.

Q. Just what is Zone Control?

A. In an apartment or other commercial building job, for instance, each tenant selects his own heat. To the building owner, sized expansion tank. The plug-in connector permits the installing contractor to test the system before the building is completed and to start heat within the building.

Q. How long does it take to install your system?

A. Even the largest boilers can be set up and in operation in less than a day. Long-length baseboard radiation covers go in *fast* without fussing with splice pieces and extensions. Length of covers is up to 20 feet.

Q. How much room does the heating unit take?

A. Not very much. A 10′ x 15′ equipment room is all you need for a 100 unit apartment. This stalled in the apartment rooms near the ceiling. A packaged zoned water chiller supplies the individual cooling units. Airvec is completely packaged in a manner never before offered to this industry.

Q. I understand that Edwards has detailed help available to engineers. Please explain.

A. Probably most important, for all types of jobs, large or small, new or remodeled, we offer you our complete handbook of Zone heating and cooling plus a *brand new* "Engineers Portfolio". The latter has complete details (on 17″ x 22″ broadsides) on heating and cooling for homes, apartments, motels and churches. Check the coupon below and send it to me.

EDWARDS ENGINEERING CORP.

Pompton Plains, N. J.
TEmple 5-2808

PACKAGED HYDRONICS THROUGH YOUR CONTRACTOR

We are interested in:

☐ Edwards complete handbook — catalog

☐ Edwards Engineers Portfolio

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COMPANY_____

ADDRESS_____

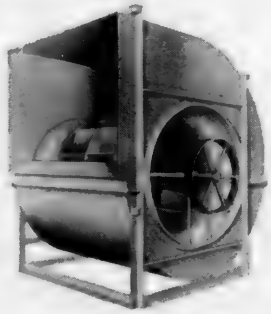
CITY_____ STATE_____

ACHV9

Feather-floating zephyr to tropical hurricane velocity . . . you name it, and specially controlled Peerless Air Moving Equipment provides it on cue. All-welded construction keeps housing and scroll firm and quiet. Obstruction-free inlets allow air to pass through the unit at unimpeded peak efficiency. Welded wheels are statically and dynamically balanced for perfect rotation. Engineers! You can specify Peerless with confidence. Contractors! You can install Peerless with ease and assurance. Users reap the benefits of quiet, dependable, inconspicuous service.

Investigate Peerless Air Moving Equipment Today! Write to Peerless Electric Division, H. K. Porter Company, Inc., 1400 West Market St., Warren, Ohio.

Manufactured and sold in the western states by Master Fan Corporation, H. K. Porter Company, Inc., 1323 Channing Street, Los Angeles 21, California. NOW AVAILABLE—Centrifugal Blowers to 132" wheel diameter, Turbo Blowers to 55" S. P., Tube and Vaneaxial Blowers and Industrial Fans to 104" wheel diameter.



PORTER **PEERLESS ELECTRIC DIVISION**
H. K. PORTER COMPANY, INC.

Member—Air Moving and Conditioning Association, Inc.

Roommate II

dramatic new concept in year-round air conditioners

For the designer who must deliver contemporary flair as well as comfortable air, Nesbitt presents the daring ROOMMATE II . . . *year-round air conditioners with line and color styling as new as their functional originality!*

Gray (Light Reflectance 48.0%) with accent panel Blue (L.R. 21.8%)

Tan (L.R. 35.0%) with Gray (L.R. 48.0%)

Yellow (L.R. 72.4%) with Coral (L.R. 26.2%)

Blue (L.R. 21.8%) with Tan (L.R. 35.0%)

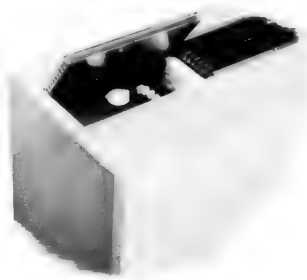
the perfect mating of comfort and contemporary styling

The new Nesbitt ROOMMATE II maintains year-round comfort in any room or office with improved efficiency and maximum economy. The units are sized to meet the needs of offices, hotels, motels, apartments, schools, hospitals, and similar spaces. Installed without expensive ducts, they are controlled to operate individually, as needed, for personal comfort.

Roommate II heats or cools, depending on season; and when it cools it dehumidifies in precise conformance to requirements within the room. The Nesbitt exclusive Humid-a-Guard Control System* assures required dehumidification even as the chilled water supply is reduced (next page).

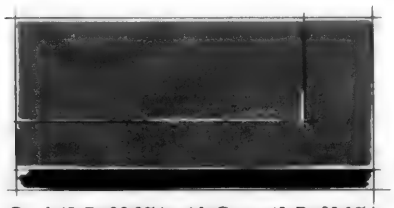
With their sharp new look, quick-changing front panels, and extruded aluminum grille, they add a touch of the contemporary to any interior design. Six tested colors in flawless baked enamel finish, used alone or in two-tone combinations, permit up to 36 different color treatments.

* patent applied for



Recessed control panel

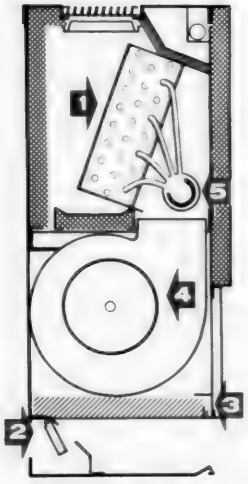
Gray (L.R. 48.0%) with Blue (L.R. 21.8%)



Coral (L.R. 26.2%) with Green (L.R. 30.1%)

Green (L.R. 30.1%) with Yellow (L.R. 72.4%)

Nesbitt ROOMMATE II *with Humid-a-Guard Control System*



Seven sizes: 140 to 1200 cfm air; 9400 to 70,000 Btu heating; 4700 to 43,000 Btu cooling; models for floor or ceiling mounting or concealed application.

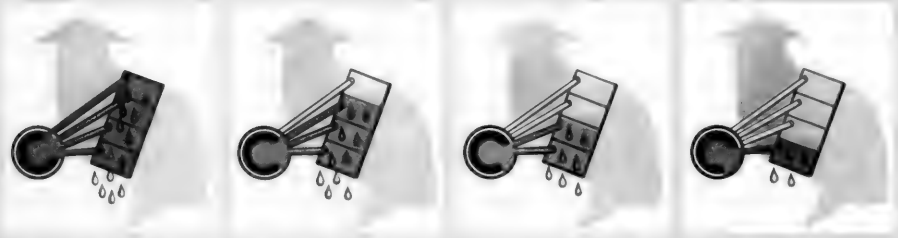
1 The Nesbitt Heating-Cooling Element is field reversible, accessible for easy cleaning. It is enclosed in a fully insulated 18-gauge cabinet, and its condensate falls onto a *removable* (for cleaning) positive-pitch drain pan made to last for the life of the unit.

2 The exclusive Nesbitt Air Volume Stabilizer Damper permits introduction of outdoor air and prevents blow-through by automatically restricting the opening as wind velocities increase.

3 Full-width Filters are removable through return air opening without taking off casing.

4 The Nesbitt direct-drive Motor and Fan Assembly is built to insure long-term freedom from maintenance problems. Whole assembly is removable; fans accessible for easy cleaning.

5 Roommate II with the Humid-a-Guard Control System protects against excess humidity.



The heat transfer element is circuited to operate as four separate sections, each controlled in sequence by the exclusive Nesbitt H-G Valve. As the load requirement for cooling decreases, the H-G Valve automatically removes one or more element sections from the flow circuit; but the remaining sections continue to cool *and dehumidify* at their full capacity. (Cross-sections show the four phases of Humid-a-Guard Control cycle.)

BASIC INGREDIENT
Excellence
Nesbitt
Heating Ventilating
Air Conditioning

For more details of Roommate II send for Publication 602.

Made and sold by John J. Nesbitt, Inc., Philadelphia 36, Pa.

R-361

Ray Edwards Answers Some Questions On:

WHY IT WILL PAY YOU TO SPECIFY EDWARDS HEATING EQUIPMENT

Q. All right, Ray, answer that question: "why will it pay me to specify Edwards hydronic equipment?"

A. Edwards makes your job easier and saves you valuable time.

Q. How?

A. Edwards offers a true package. Everything having to do with the hydronic heating system can be specified from one source — that means: boiler, motorized valves, circulator, baseboard radiation. Why spend your time searching and figuring when you can get everything from one manufacturer? All Edwards heating units come completely wired so that no further on-the-job wiring is required.

Q. That's all very well, but the most important factor to me is the company behind the product—

A. Good, Edwards has been for many years a basic manufacturer of heat transfer components and equipment for residential, commercial and industrial use. We have gained a reputation for leadership in developing new systems and equipment —

Q. For instance?

A. Let's take Zone Control which Edwards pioneered. Zone heating, properly engineered, will save the end — user up to 30% in fuel costs.

Q. Just what is Zone Control?

A. In an apartment or other commercial building job, for instance, each tenant selects his own heat. To the building owner, this means very economical fuel consumption. Fuel savings of 25% to 30% are possible.

Q. Why does Edwards Zone heating cut fuel costs for the apartment owner?

A. The occupants on the upper floors do not get so hot that they have to open windows. A multistory apartment house is like a giant chimney—the upper floors receive most of the heat *unless the apartments are individually controlled.*

Q. Any other reasons why it pays to specify Edwards equipment?

A. Labor-saving installation. The Edwards heating unit comes complete with plug-in electrical connector, built-in automatic air elimination devices and correctly sized expansion tank. The plug-in connector permits the installing contractor to test the system before the building is completed and to start heat within the building.

Q. How long does it take to install your system?

A. Even the largest boilers can be set up and in operation in less than a day. Long-length baseboard radiation covers go in *fast* without fussing with splice pieces and extensions. Length of covers is up to 20 feet.

Q. How much room does the heating unit take?

A. Not very much. A 10′ x 15′ equipment room is all you need for a 100 unit apartment. This gives the owner more room for more apartments.

Q. How about price?

A. The Edwards system has the lowest installed price of any system being marketed.

Q. I understand we can use your system for heating swimming pools and snow melting.

A. True. For heating a swimming pool, just ask us to add a low-cost inter-changer and Zone Control valve. The same applies for snow-melting.

Q. What about cooling?

A. Edwards Airvec is the answer. This is another example of Edwards pioneering. It consists of a noiseless gravity operated air-cooled condenser connected to noiseless gravity air cooling units inconspicuously installed in the apartment rooms near the ceiling. A packaged zoned water chiller supplies the individual cooling units. Airvec is completely packaged in a manner never before offered to this industry.

Q. I understand that Edwards has detailed help available to engineers. Please explain.

A. Probably most important, for all types of jobs, large or small, new or remodeled, we offer you our complete handbook of Zone heating and cooling plus a *brand new* "Engineers Portfolio". The latter has complete details (on 17″ x 22″ broadsides) on heating and cooling for homes, apartments, motels and churches. Check the coupon below and send it to me.

EDWARDS ENGINEERING CORP.

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PACKAGED HYDRONICS THROUGH YOUR CONTRACTOR

We are interested in:

- ☐ Edwards complete handbook — catalog
- ☐ Edwards Engineers Portfolio

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COMPANY_____

ADDRESS_____

CITY_____ STATE_____

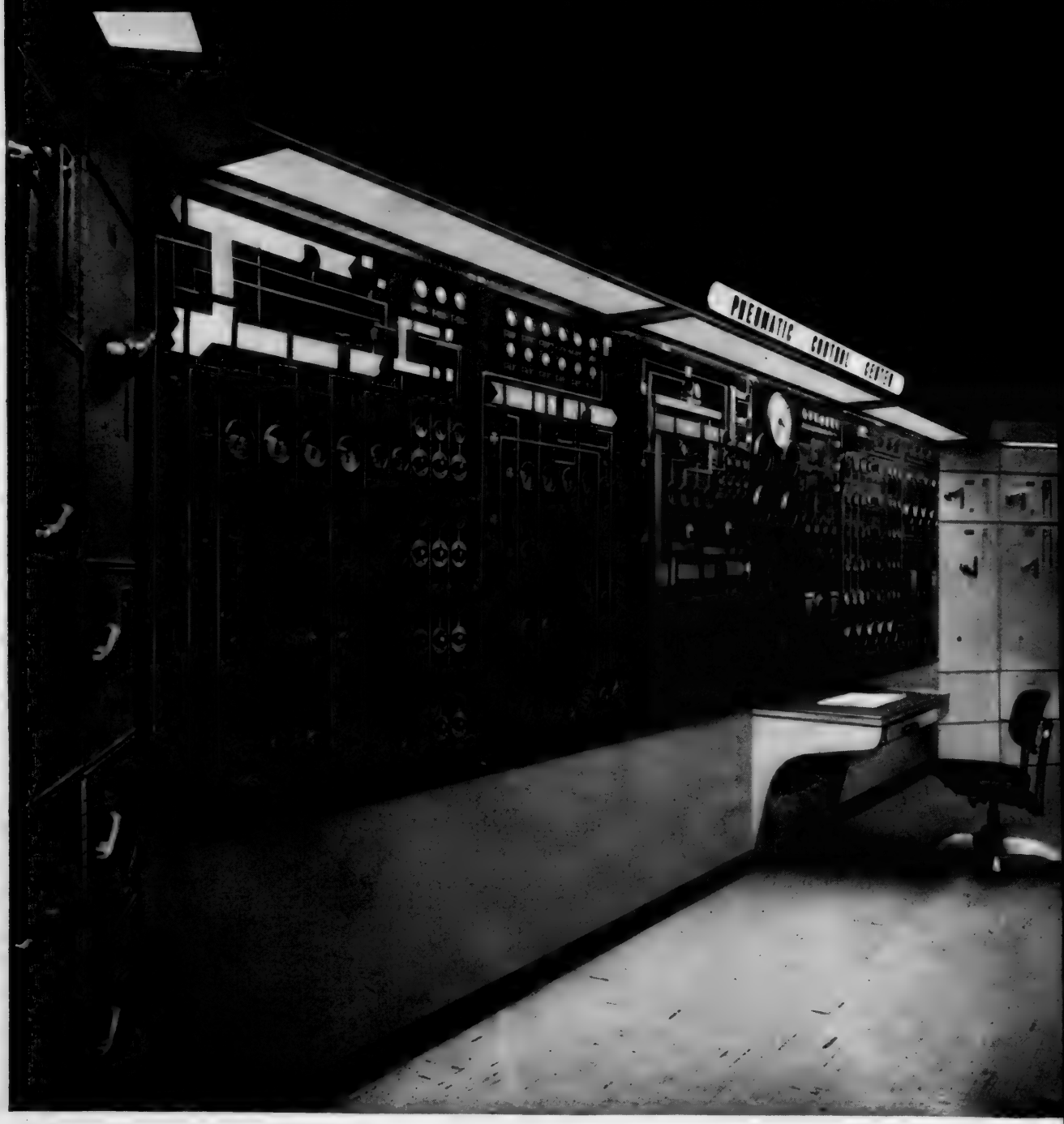
ACHV9

Architects and Engineers
Fellheimer & Wagner, New York

General Contractor
Southeastern Construction Co., Charlotte, N. C.

Mechanical Contractor
B. & G. Olsen Co., Richmond, Va.

Engineering Building



Development Laboratory

Where Controlled Environment Counts, It's
JOHNSON PNEUMATIC CONTROL

. . . at Union Carbide Technical Center, for example

The new Union Carbide Technical Center in South Charleston, W. Va., is one of the most modern R&D facilities in industry today. It includes 12 buildings where over 1000 scientists and engineers carry out important assignments for Union Carbide Chemicals Company, Union Carbide Olefins Company, and Union Carbide Plastics Company.

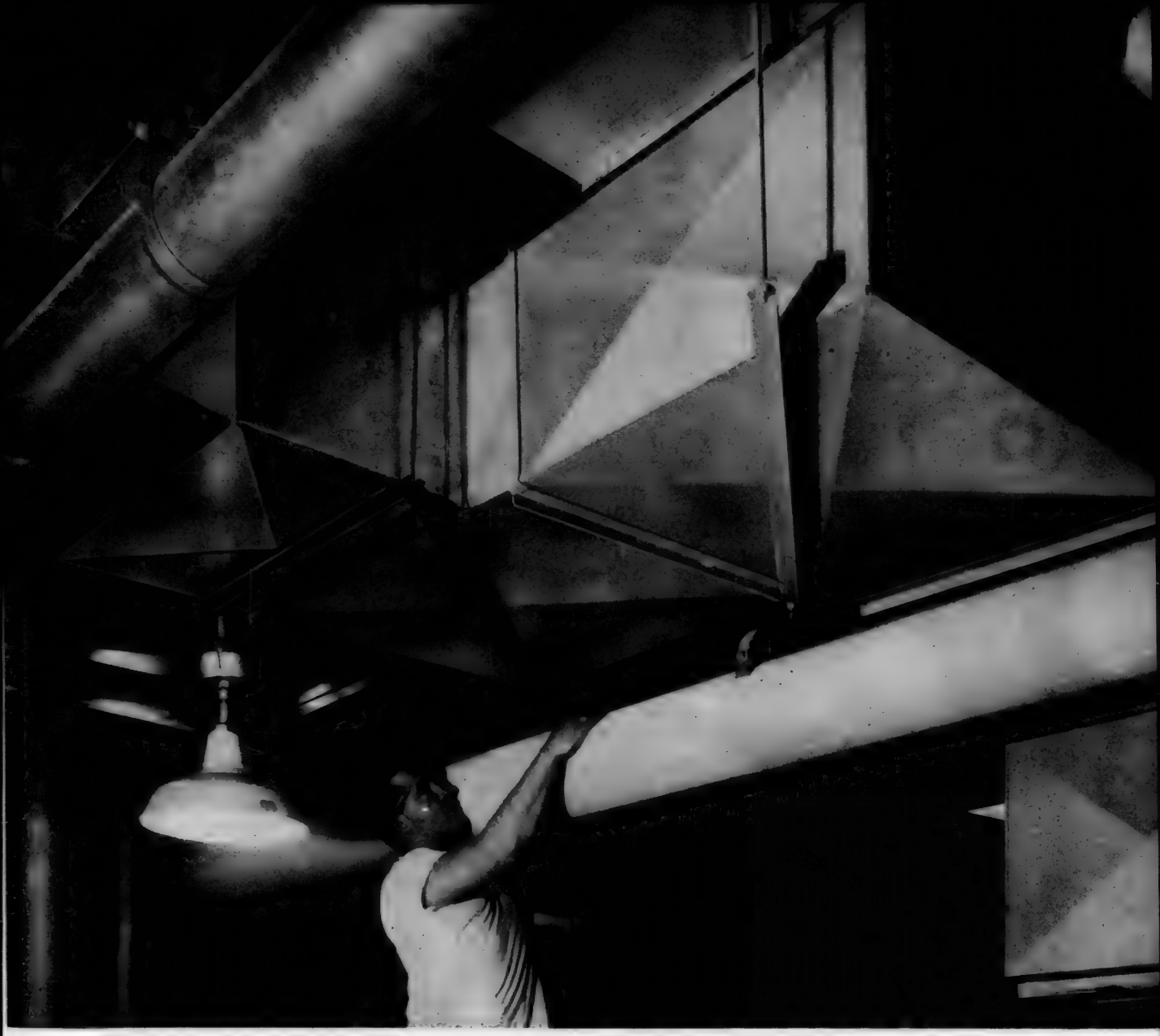
A closely controlled thermal environment is especially important to the Center's operation, being essential to much of the experimental work as well as to the comfort and efficiency of the staff.

Specially engineered Johnson Pneumatic Control Systems help meet both types of demand with equal precision. Whether it's personal comfort in a private office, or special thermal conditions for individual projects in the Development Laboratory, the High Pressure Laboratory, or the Pilot Scale Laboratory buildings, Johnson Control maintains the exact air conditions required at all times.

Johnson Pneumatic Control is applied to all types and makes of air conditioning, heating, and ventilating equipment, and to a wide range of industrial processes. Next time you have a problem of temperature, humidity, or pressure control, investigate the advantages you get from a Johnson System — in performance, dependability, and lifetime economy. Johnson Service Company, Milwaukee 1, Wisconsin. 110 Direct Branch Offices.

JOHNSON CONTROL
PNEUMATIC SYSTEMS
DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

A Johnson Pneumatic Control Center permits centralized supervision and control of air conditioning in the Engineering Building. Pneumatic indicators continuously display temperatures and pressures from all key control points. Remote adjustments may be made without leaving the panel. Selector switches place any system on either manual or completely automatic operation, as desired. In addition, local graphic panels, with temperature and pressure indication, are located in fan rooms adjacent to units. The system makes use of polyethylene tubing for compressed air piping.



Bethcon Galvanized Sheets form up easily for ductwork that's strong and rigid

Bethcon galvanized steel sheets get a special annealing treatment that gives them a desirable blend of ductility and stiffness. That's why you can form them up easily into ductwork that is rigid and strong.

Bethlehem's continuous galvanizing process applies zinc to steel so tightly that it will not peel or flake off even when the sheet is doubled back on itself.

You can get Bethcon in a wide variety of gages, in coils or in cut lengths. A Bethlehem representative is located near you, and he will be glad to give you all the details you need.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Sales: Bethlehem Steel Export Corporation

for Strength
... Economy
... Versatility

BETHLEHEM STEEL

BETHLEHEM STEEL

Hermetic...they're Leakproof !

NEW 'BUFFALO'

CAN-O-MATIC® *PUMPS*

with self-adjusting bearings

Now, from Buffalo Pumps, a leakproof line of totally enclosed hermetic pumps so simple in design they can be taken apart and re-assembled with open-end wrenches and a screwdriver.

Designed for the chemical, petrochemical, atomic energy, and marine industries, the new Can-O-Matic's are the most practical, durable and easily maintained pumps in the hermetic field.

Long-life bearings represent a great new advance in canned pump design. Lubricated by the liquid being pumped, they absorb both radial and axial thrusts... automatically compensate for bearing and journal wear. Toxic or volatile, liquids cannot escape... air cannot leak in.

Thirteen sizes with 1" to 5" discharges are now available for a wide range of applications. Standard units with stainless steel rotor cans are designed for 120 psig and 40° through 250° F. operations. Special models are available for higher pressures and temperatures, and a variety of dangerous corrosive liquids.

For additional information and specs, contact your resident Buffalo representative, or write direct for Advance Bulletin 977.

"Buffalo" PUMPS

BUFFALO PUMPS DIVISION

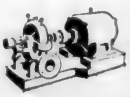
BUFFALO FORGE COMPANY

Buffalo, New York

CANADA PUMPS LTD., KITCHENER, ONT.

'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.



'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

PPG Fiber Glass Pipe Insulation is slit lengthwise, slips easily on to pipe. Delaware Insulation Company installed 15,000 ft of PPG Pipe Insulation in the new Wilmington High School, reported excellent working characteristics.

"We can install PPG Fiber Glass Pipe Insulation 15% faster than other pipe insulating materials"

says Mr. Anthony Kotowski, foreman, Delaware Insulation Company, Wilmington, Delaware

"A good worker can insulate 200 feet of pipe in one work day. But with PPG Pipe Insulation, he can insulate 230 feet in the same amount of time," reports Mr. Kotowski. "This helps us maintain tight construction schedules and saves money, too!

"We like PPG Fiber Glass Pipe Insulation because it's flexible and workable. We bend it around pipe hangers, mold it to shape easily, smooth it, then fasten and bind it," continued Mr. Kotowski as he discussed the PPG installation in a Wilmington High School. "You can't do that with other insulations. They're too brittle, require cutting, and sometimes break when you're working with them.

"PPG Pipe Insulation is easy on the hands, and it's not attacked by rodents. Of all the insulations on the market, PPG gives the neatest, quickest job."

GET TOP RESULTS WITH PPG

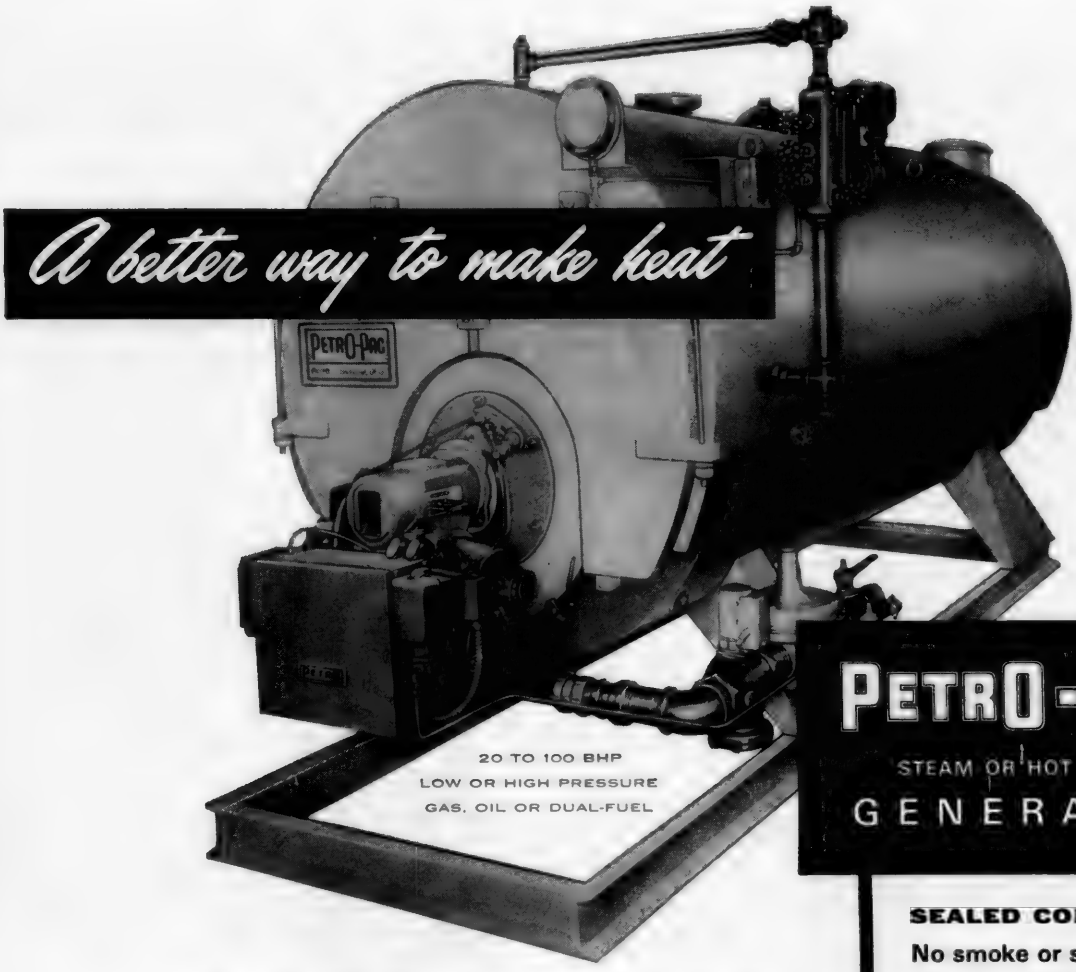
Fast installation, excellent thermal insulation, long service life, low maintenance . . . all these advantages are yours with PPG Fiber Glass Pipe Insulation. It's available in a full range of sizes, with or without facing.

For full information, contact your nearest PPG Fiber Glass Sales Office, or write *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Penna.*

FIBER PG GLASS

PITTSBURGH PLATE GLASS COMPANY

Sales Offices: Atlanta, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Houston, Kansas City, Louisville, Los Angeles, Miami, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis and Seattle.



A better way to make heat

PETRO-PAC

STEAM OR HOT WATER

GENERATOR

SEALED COMBUSTION

No smoke or soot. Cuts standby loss to practically nothing.

PRESSURIZED

No stack—vent only. No flame pulsation. Low electric power requirement.

3-PASS, WET BACK

No refractory maintenance. Low fuel cost. Combustion efficiency 80% or better.

Real, top-grade, season-long efficiency can only be achieved by *precision* control of the entire combustion process. The whole combustion system is sealed, clear through to the exhaust vent. No draft regulator; no unreliable natural draft; no air infiltration; no dissipation of boiler heat during off periods. The only air admitted is *metered* air. New, unique burner design reaches maximum heat output, without smoke or soot, within a half-dozen seconds. Rear furnace is surrounded by water, preventing heat loss and gas leakage, and avoiding the expense of refractory maintenance. Each pass of tubes terminates in a separate tube sheet to minimize stresses of expansion and contraction. The Petro-Pac is a thoroughly engineered unit, built for exceptional fuel economy, low upkeep, minimum supervision and long life.

Mail coupon for technical data.

PETRO

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Makers of quality heating and power equipment since 1903

PETRO, 3311 W. 106th St., Cleveland 11, Ohio
(In Canada, 80 Ward Street, Toronto, Ontario)

Please send me literature and specifications of Petro-Pac generator.

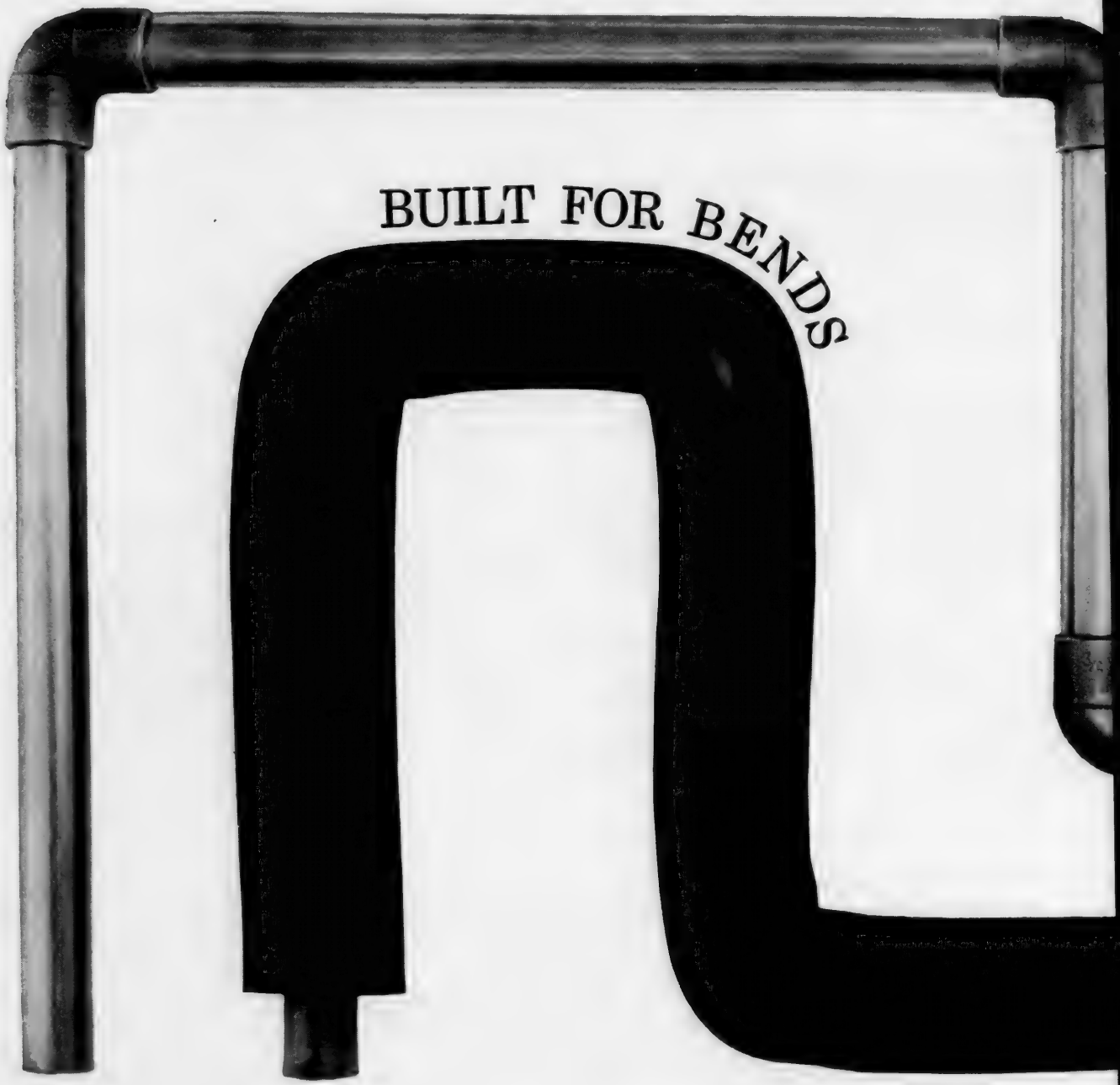
Size _____ Pressure _____

Name _____

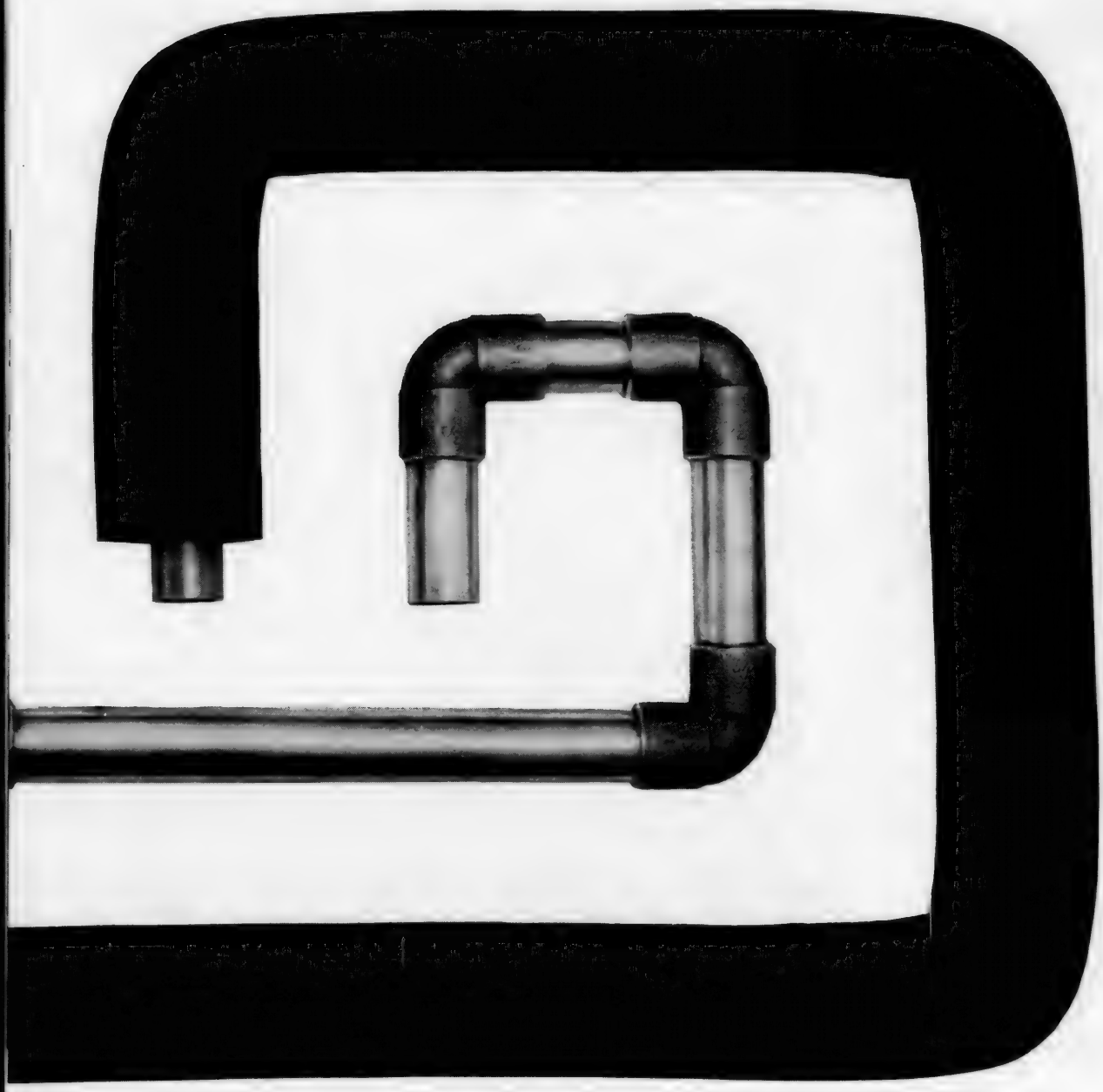
Company _____

Address _____

City _____ State or Prov. _____



J-M Aerotube... a flexible, anti-sweat insulation designed for quick installation on bent tubing!

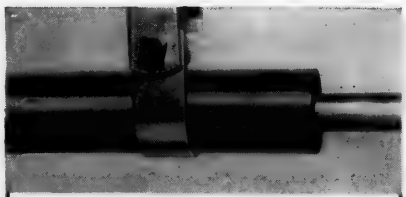


Now you can end the problem of pipe condensation on any indoor line quickly, easily and economically. With Johns-Manville Aerotube® even the most complex bend is a snap to insulate.

Aerotube is a flexible, foamed-plastic pipe insulation for use at temperatures from 32F to 220F. Its closed-cell structure prevents the passage of moisture under normal design conditions on indoor lines.

Because Aerotube is a flexible product (you can actually tie it in knots), it permits unique installation economies. The six-foot lengths go on quickly and easily. On new installations, simply slide Aerotube over tubing or pipes. For existing installations just slit Aerotube, snap it on and cement joints. That's all. Field reports show that installation costs can actually be cut in half.

If you have a condensation problem on heating, plumbing or air conditioning service lines, Aerotube can solve it. For full details, write to J. B. Jobe, Vice President, Johns-Manville, Box 14, New York 16, N.Y. In Canada: Port Credit, Ontario. Cable: Johnmanvil.



ALSO AVAILABLE...
A RIGID AEROTUBE

For compression-free insulation at pipe supports or for underground use, J-M's rigid Aerotube is recommended.

JOHNS-MANVILLE

AN INSULATION FOR EVERY COMMERCIAL AND INDUSTRIAL USE

JOHNS MANVILLE JM PRODUCTS

Now—17 Trane Torrivent large area heating-

Two-fan unit. Vertical floor-mounted or wall-hung unit with de luxe discharge plenum and intake box.

New Auditorium Torrivent (*horizontal*). Used in factories, auditoriums, convention halls, gyms, etc. Extremely quiet, economical to operate.

Expanded size range lets you choose a unit that fits your job exactly

Now from the TRANE Torrivent line you can select the capacity you need to meet the requirements of any large interior space. Thorough testing and rating of the Torrivent as a unit assures accurate capacity ratings.

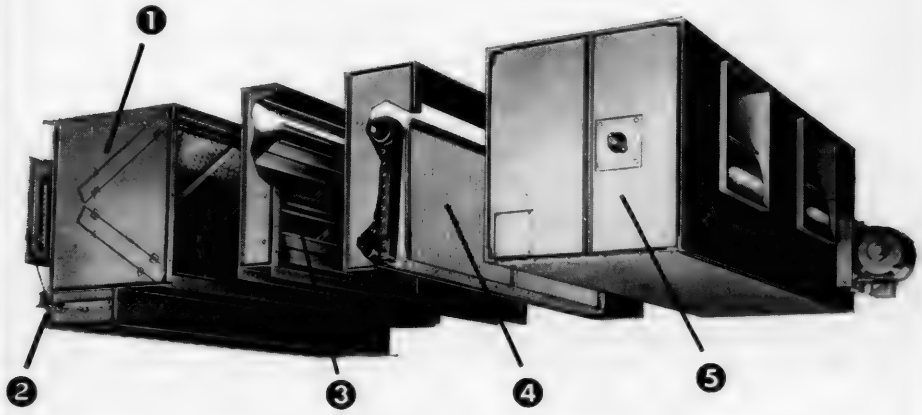
Versatile line. Seventeen Torrivent sizes give you a selection of heating capacities that range from 20,000 to 3,800,000 Btu. Choice of six models—vertical floor; horizontal ceiling; inverted ceiling; horizontal floor; vertical wall; inverted wall—with one to three fan units delivering from 600 to 54,000 cfm.

Sectionalized construction. You get the benefit of sectionalized construction that permits flexible use of any of the matched components and accessories. This is why Torrivent is a highly flexible line—adaptable for more applications.

Exclusive coil design. New TRANE NS Steam Distributing Coil with exclusive Kinetic Orifices and 1″ OD tubes assures even temperature distribution across entire coil face.

Find out more. Ask your nearby TRANE sales office for complete facts on the Torrivent line. Or write TRANE, La Crosse, Wisconsin.

sizes to solve more ventilating problems!



1 Combination filter-mixing box. Mixing box damper blades set to direct two streams of entering air on a merging course—reduces stratification. All air is thoroughly filtered.

2 Ball-joint damper linkage. Nonbinding, prelubricated ball-joint damper linkage is used on all face-and-bypass and mixing box sections. Absorbs minor misalignment and stress. Requires little maintenance.

3 Face-and-bypass dampers. Internal face-and-bypass section uses opposed blade dampers for accurate temperature control. Blades are locked securely and permanently positioned on splined rods which rotate on rustproof, permanently-lubricated nylon bushings. Moving from fully closed to fully open, relative position of blades will not vary.

4 Heating coil. New TRANE Sigma-Flo Coil assures greater effectiveness in heat transfer. Turbulent action on fin surface prevents buildup of any insulating film of air. Steam distributing coil design with 1" OD tubes virtually eliminates condensate bridging—protects against freeze-up. One row of tubes meets most capacity requirements.

5 Fan section. Fans have low outlet velocities for smooth operation. Every fan section balanced electronically after complete assembly—assures efficient, quiet operation.

Torrivent design assures lower operation and maintenance costs

Low operating cost. Torrivent fans, manufactured by TRANE, have an advanced design that assures peak operating efficiency. Fan horsepower requirements are kept low for economical operation. TRANE also offers a wide selection of sizes and unit combinations —so you don't pay for operating unneeded capacity.

Low maintenance cost. All coils are removable and accessible. Coils are pitched in every unit to give complete drainage.

Ball bearings are lubricated for life. Reduces maintenance—eliminates danger of improper lubrication. Bearings selected for a service factor of 3.

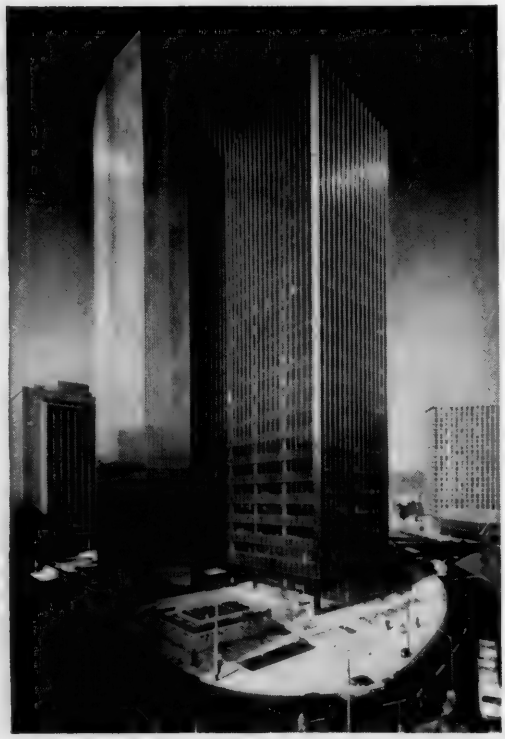
Rugged construction. Casing and accessories are uniframe construction, with heavy gauge phosphatized steel. Coils have heavy semi-steel cast headers with tubes rolled and bushed for longer life.

For any air condition, turn to

TRANE

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA. • CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA LIMITED, TORONTO
100 U. S. AND 19 CANADIAN OFFICES



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Pittsburgh, Pennsylvania

EQUITABLE LIFE ASSURANCE SOCIETY
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Performance records of millions of Sloan Flush Valves indicate that when this new building is 50 years old its Sloan Flush Valves will still provide dependable service.

Because the Sloan ROYAL is acknowledged as the world's most successful flush valve, attempts have been made to imitate some of its most important features. But why gamble with substitutes when you can plan for the life of the building confidently with Sloan? Specify and insist upon performance-proven, time-tested Sloan Flush Valves.

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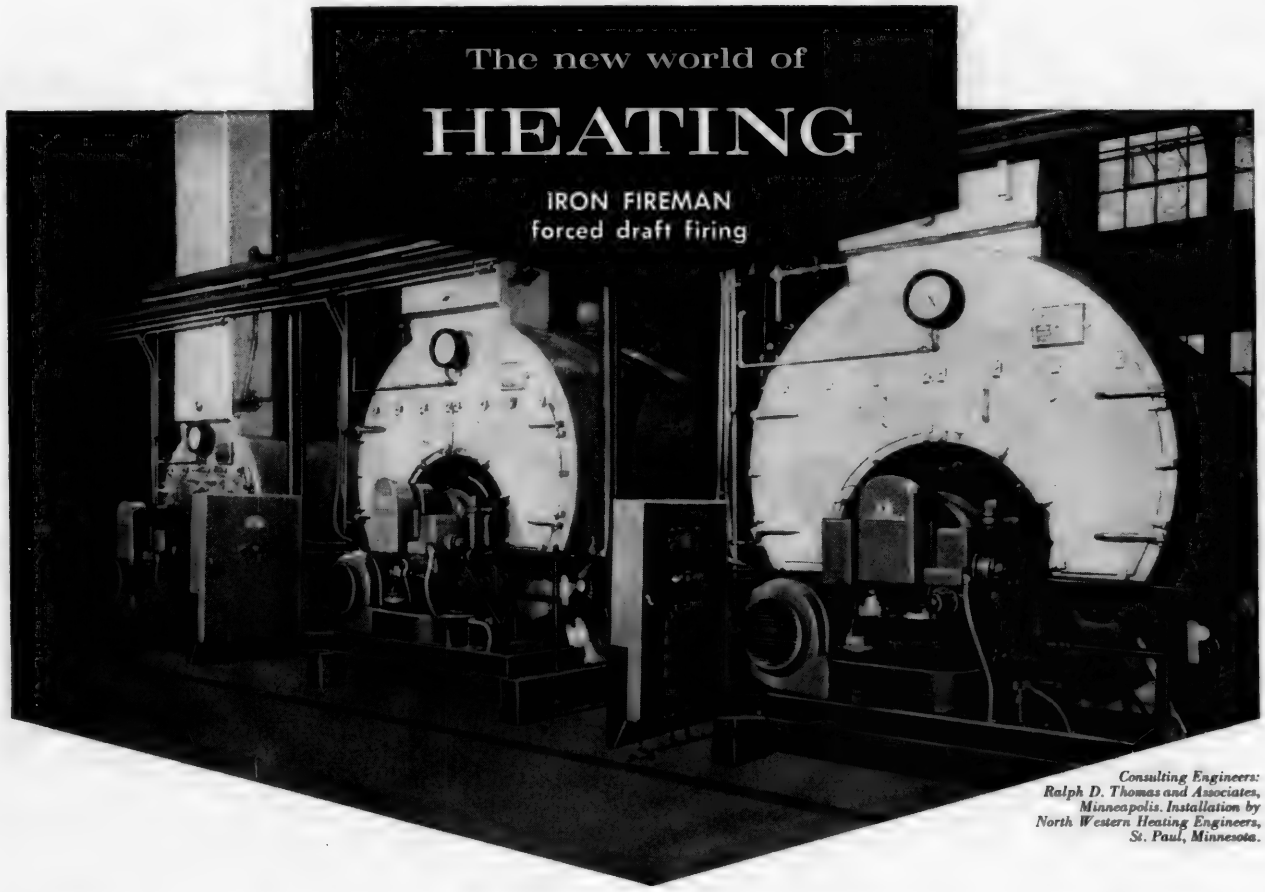
SLOAN
FLUSH VALVES



Consulting Engineers: Ralph D. Thomas and Associates, Minneapolis. Installation by North Western Heating Engineers, St. Paul, Minnesota.

This new heating plant increased boiler capacity 70%, yet will return the investment in 7 years

The Minnesota Masonic Home in Minneapolis faced a problem that is familiar to many owners of old heating plants—should the old plant be modernized or replaced?

After a thorough study of several alternatives, the engineering firm of Ralph D. Thomas and Associates recommended a complete replacement. The three Iron Fireman-Kewanee boiler-burner units shown above provide extra capacity for future needs, while cutting steam costs so sharply that engineers estimated they will pay for themselves in seven years.

COMPLETE, PACKAGED FIRING SYSTEM

The first big saving was in installation—the three units were moved in intact. No boiler settings, no brickwork, no special wiring required. The factory assembled units included boilers, burners, forced draft air supply, wired and tested control panels and fuel systems, all mounted on a permanent base. Low operating costs were the result of high combustion efficiencies (reduced fuel bills) and low maintenance. With packaged installation, factory responsibility covers practically the entire job.

FOR OIL, GAS OR DUAL-FUEL FIRING

Oil models fire any grade of oil from No. 2 to No. 6. Gas models take any type of high or low pressure gas. With dual-fuel models, fuels can be switched at a moment's notice with either manual or automatic controls.

Mail coupon for full information.

IRON FIREMAN

HEATING AND AIR CONDITIONING
AIRCRAFT COMPONENTS AND EQUIPMENT
MISSILE AND AIRCRAFT GYROSCOPES
ELECTRONIC EQUIPMENT
CONTROL INSTRUMENTS

IRON FIREMAN MFG. CO., 3132 W. 106th St., Cleveland 11, Ohio
(In Canada, 80 Ward St., Toronto)

Please send complete technical description and specifications on Iron Fireman forced draft firing.

Name_____

Firm_____

Address_____

City_____ State or Prov._____

NEW FROM BARBER-COLMAN

Improvements in high

MODELS FOR EVERY REQUIREMENT

Model CVE with open-end delivery

Model CVD with integral diffuser

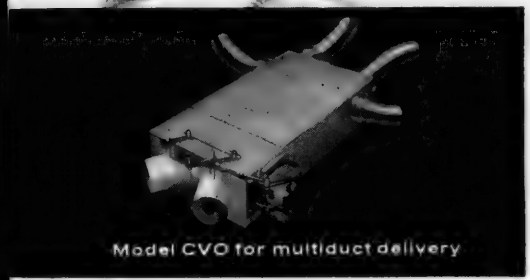
velocity air control

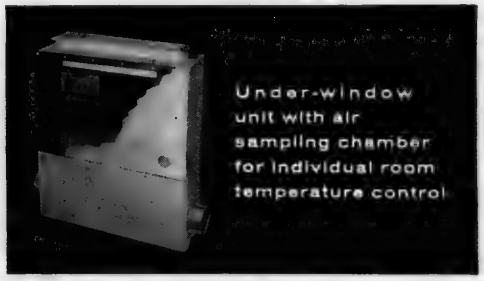
Double-duct control units with new Uni-Valve design provide tight shutoff . . . extreme simplicity . . . and lower sound levels

Before you design a double-duct high velocity air distribution system, check these advantages of *improved* Barber-Colman control units which mix hot and cold air, reduce it to conventional velocities, and deliver constant cfm output to branch ducts or diffusers:

- Flexibility of inlet location.
- Easier system design and layout for the engineer.
- Easier installation for the contractor.
- Exclusive external operator location for accessibility. (Internal operator mounting can be provided if required.)
- Exclusive adaptability to electronic, electric, or pneumatic controls.
- Constant volume and temperature control with a single operator.
- Complete range of sizes from 100 cfm to 5000 cfm.

For complete information, call your local Barber-Colman Air Distribution Products Field Office, or write direct to the factory for literature.


Model CVO for multiduct delivery

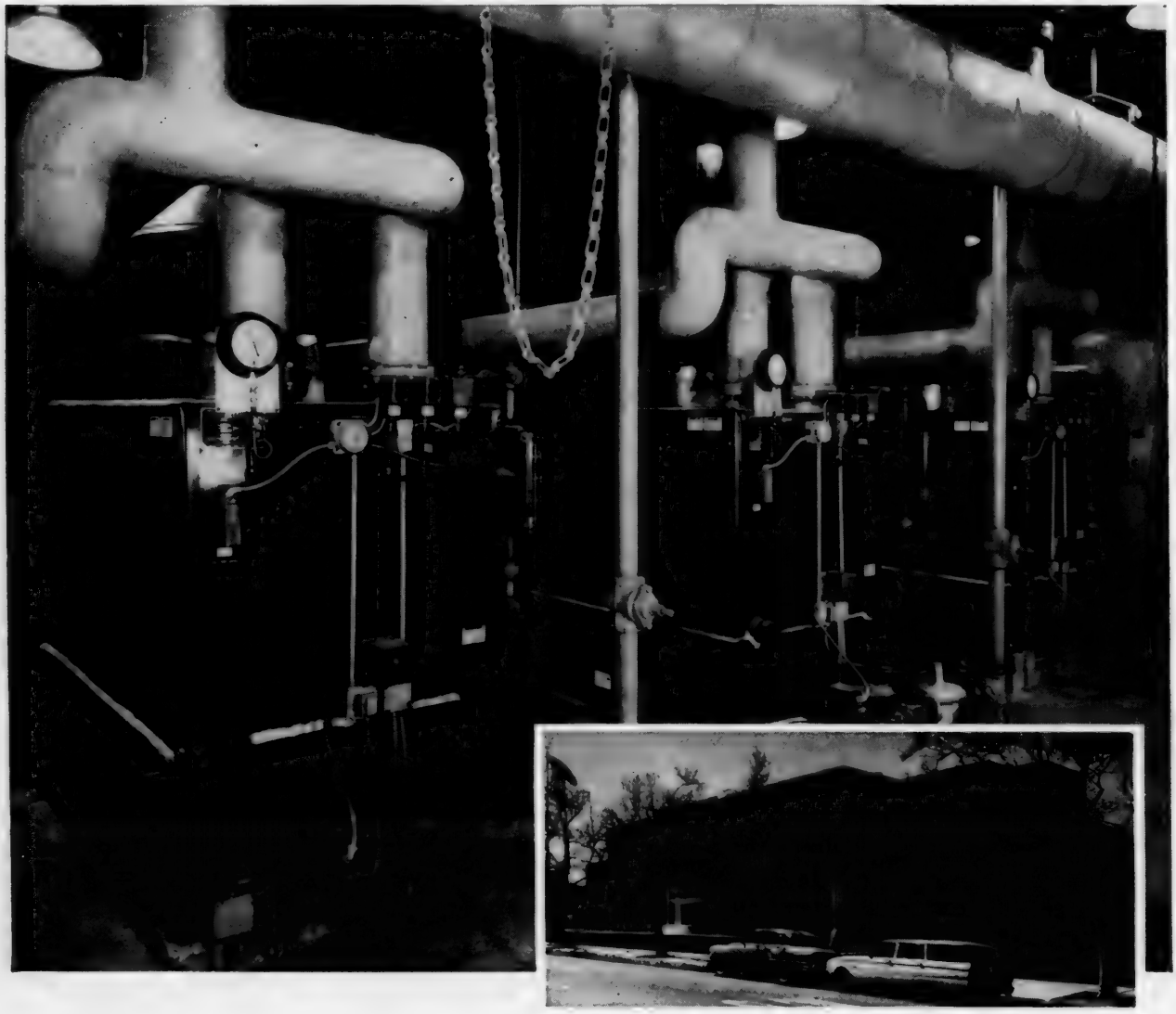

Under-window unit with air sampling chamber for individual room temperature control

BARBER COLMAN

BARBER-COLMAN COMPANY

Dept. V, 1102 Rock Street, Rockford, Illinois

. . . where originality works for you



Alexander Fleming Junior High School, Lomita, California

In a California Jr. High **Bryan Boilers**

keep pace with temperature changes

Bryan Copper Tube Boilers are designed and built to the requirements of the A.S.M.E. Code. Gas-fired models A.G.A. approved.

Bryan
COPPER TUBE
Boilers

When the temperature on a January school day starts out in the low 30's and ends up in the high 60's, the school building heating system has to adjust quickly without wasting heat. A gas fired Bryan Steam Boiler system was designed for Alexander Fleming Junior High School, Lomita, California, to keep pace with this kind of temperature change. It does the job efficiently, effectively, economically.

Architects—James R. Friend & C. G. DeSwarte Los Angeles, California

Mechanical Engineer—Hugh Carter Engineering Co., 2029 Atlantic Ave., Long Beach, California

Heating Contractors—Leo Plumbing Company—A. L. Lock & Son Los Angeles, California

Bryan Sales Rep.—Heat & Power Equipment Co., 3430 Sunset Blvd. Los Angeles, California

BRYAN STEAM CORPORATION • Peru, Indiana

In 1953 a leading oil company used **Gilsulate** to insulate and protect underground hot pipes at their New Jersey plant.

This was followed by installations at their Bulk Storage Plant in New York, and their refineries in Louisiana and New Jersey.

And in 1958 they used over 650 tons of **Gilsulate** to protect their underground hot pipes at their Research Center in New Jersey.

Why? ***The Answer is obvious:*** From the standpoint of installation cost, thermal efficiency and service life, there is no better method of insulating and protecting underground hot pipes against corrosion, chemical and electrical attack than the use of GILSULATE.

Let us send you technical information on GILSULATE. Once you have learned the merits of this poured-in-place material we feel certain you will want to write your "specs" to assure the use of GILSULATE. And remember, the installation of every GILSULATE job is engineer-supervised from start to finish.

The insulation for superior protection of underground hot pipes

Gilsulate®

American Gilsonite Company | Municipal Airport P. O. Box 15 | Salt Lake City, Utah

Affiliate of Barber Oil Corp. & Standard Oil Co. of California • Distributors in Principal Countries of the World

The Honeywell Thermostat

MECHANICALLY NEW INSIDE...BEAUTIFULLY NEW OUTSIDE

FEWER WORKING PARTS

LOW-MASS SENSING ELEMENT

9 NEW FINISHES

Now offer your customers more accurate, more sensitive and more colorful temperature control.

Honeywell's simplified construction protects critical working parts in the base. A low-mass sensing element provides immediate response to temperature changes. The heavy gauge steel cover stands up to the toughest abuse. Seven finishes are electro-plated for lasting beauty—highly impervious to scratches and smudging. Two finishes are tough, baked-on enamel.

The new Honeywell Round is easier to read and set, too, with white numerals on a black background. With its new finishes, you and your architect can offer clients a wider choice—at no increase in cost!

Install Honeywell controls to assure your customers of the finest, smoothest heating and cooling.

Be sure you tear out the color chart on the next page to help you sell your prospects. For assistance on your next job, contact the Honeywell representative in your territory. ***Sales and service offices in all principal cities of the world.***

TEAR OFF AND SAVE!

LOOK AT ALL THE FINISHES YOU CAN OFFER!

SATIN CHROME. A brushed chromium plated surface. This finish supplied if no other specified.

POLISHED NICKEL. A bright, plated surface with a little softer tone than the polished chrome.

POLISHED CHROME. A bright chromium-plated surface, ideal for hospitals and other institutions.

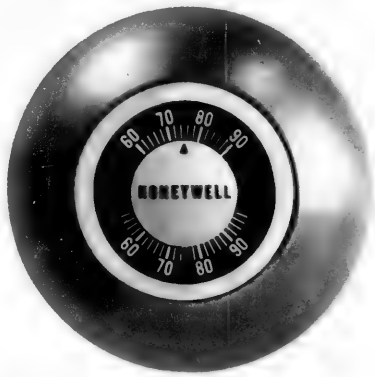
SILVER BRONZE. A brushed silvery-bronze baked enamel surface with diamond luster coating.

STATUARY BRONZE. A rich, darker brushed bronze tone, plated. Heavy gauge steel cover resists abuse.

BOWER BARFF BLACK. A soft, black painted surface that adds a unique decorating touch.

BRUSHED BRASS. A soft, brushed golden brass color. Electro-plating keeps appearance years longer.

POLISHED BRASS. A gleaming golden-brass tone, plated. Virtually scratch-proof, smudges wipe off easily.



SATIN NICKEL. A brushed plated surface that is neutral in tone. All finishes resistant to corrosive atmospheres.

ONLY HONEYWELL DESIGNS, MANUFACTURES AND INSTALLS ALL THREE KINDS OF TEMPERATURE CONTROL—pneumatic, electronic and electric

Honeywell

First in Control

H HONEYWELL SINCE 1885

TYPE "J" GAS BOILERS
A.G.A. gross output: 480—4,320 MBH

QUIET

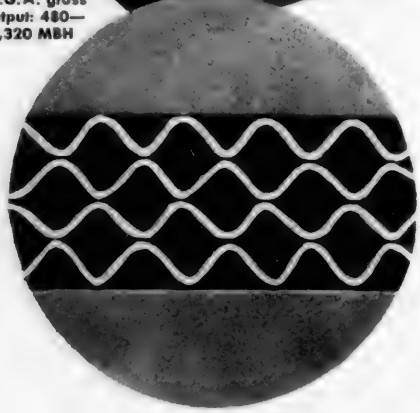
A favorite for school installation

The Weil-McLain Type "J" Gas Boiler is a valuable aid in conserving space... not only because of compact design but because amazingly quiet operation permits a wide choice of boiler room location.

The ribbon burners used on Type "J" boilers are designed for quieter operation, assuring noiseless ignition and flame extinction. A new flame carry-over principle provides quick and silent light-off with a minimum number of standing pilots. A gas valve with a slow opening feature is furnished as standard equipment and further contributes to quiet operation.

The "J" Boiler has no motors or fans which in other types of boilers are sources of noise and demand heavy use of electricity! It does not need a high chimney which conflicts with modern architecture... products of combustion can be expelled with only a five foot vent riser beyond the draft hood openings.

These boilers are A.G.A. approved and I=B=R rated. They are available in 33 sizes, increasing in increments of only 500 gross sq. ft. For full information write for Bulletin C-297 or see Sweet's Architectural File or Engineer's Product File.

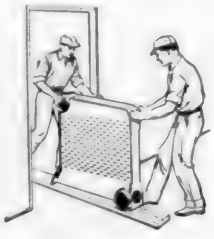


QUIET RIBBON BURNERS

Herringbone stainless steel ribbon burners are flexible over a wide range of gases, facilitating dual-fuel operation. This flexibility is also an important consideration where a switch to natural gas from other gases is expected in the future.

BOILERS FOR OTHER FUELS

Weil-McLain Boilers for commercial, industrial and institutional installations are available for gas, oil, heavy oil, combination gas-light oil, or coal. For full information, write Weil-McLain Company, Michigan City, Indiana, or see Engineer's Product File or Sweet's Architectural File.



The sections of any Weil-McLain Oil or Gas Boiler, regardless of size, can be passed through an ordinary door.

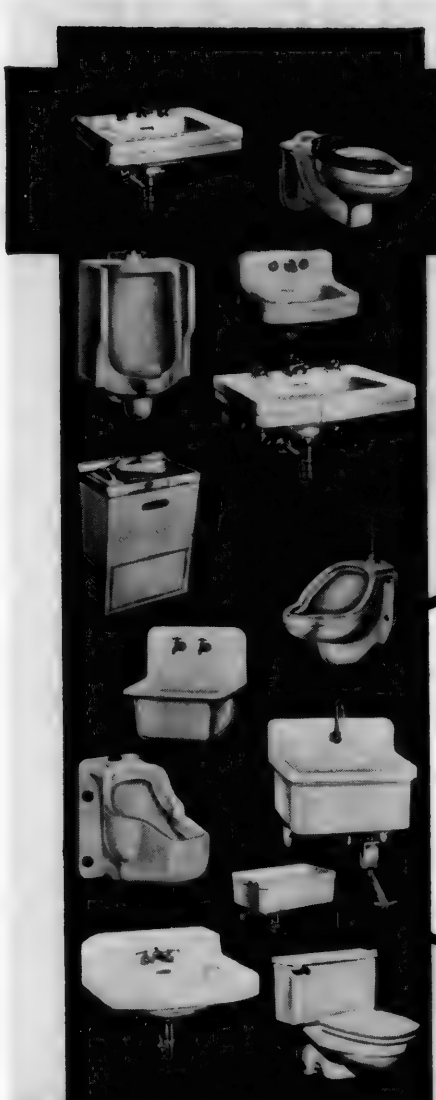
WEIL-McLAIN

CAST IRON BOILERS

"BOILERS WITH A FUTURE"

WEIL-McLAIN COMPANY, INC. • DEPT. BB-91 • MICHIGAN CITY, INDIANA

DO YOU KNOW
THE RIGHT CARRIER FOR EACH FIXTURE ?



TO SUPPORT ANY FIXTURE OFF THE WALL

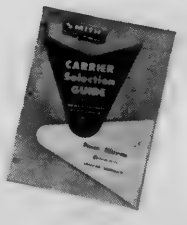
SPECIFY SMITH CARRIERS

When it comes to the question of knowing the right carrier to use with any type or make of Wall-Hung Fixture, you'll find you always get the right answer, and the right carrier, when you Specify Smith.

With a complete line of over 100 different types and sizes of Wall-Hung Fixture Carriers, there's a Smith Carrier that's just right for supporting any Make, Type, or Size of Fixture.

So that you may know the right carrier to use in supporting any Wall-Hung Fixture, Smith Carrier Selection Guides are available to help you quickly find the answer.

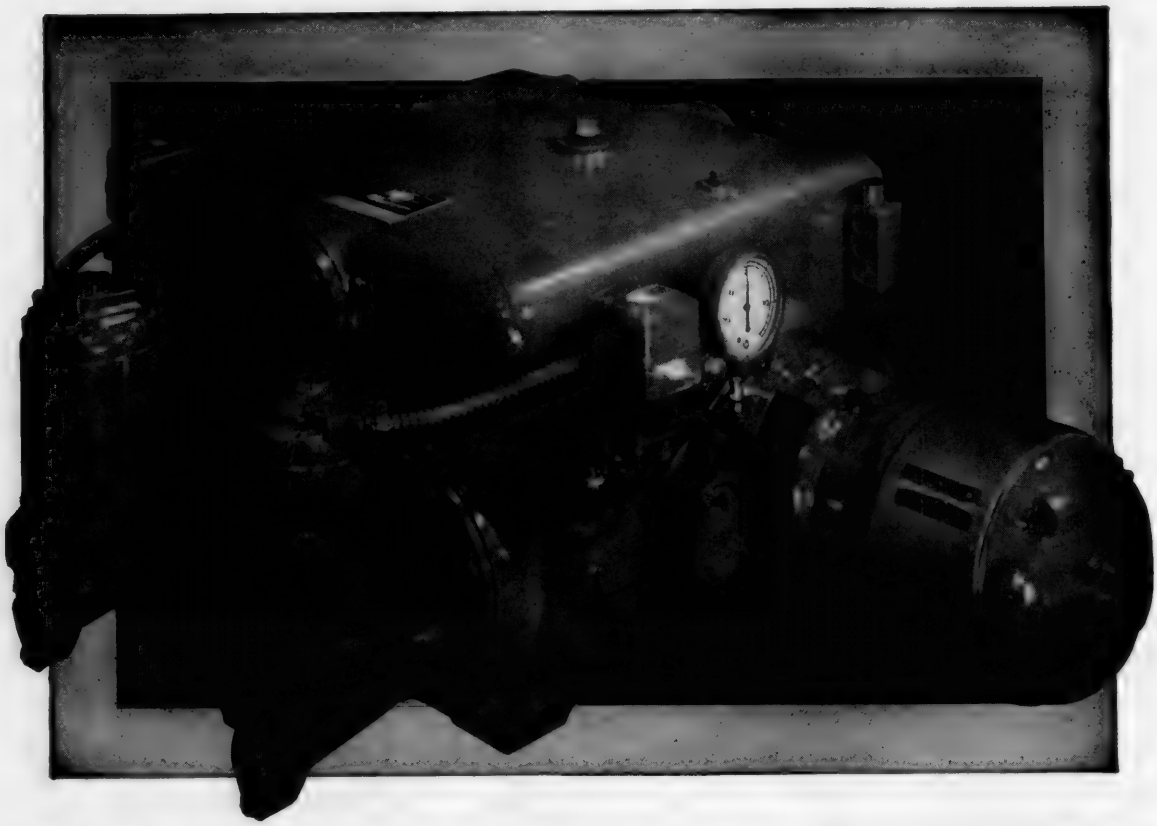
To obtain any of these helpful Carrier Guides, we invite you to write, or "Just Ask Your Local Smith Representative."



JAY R. SMITH MFG. CO. Union, New Jersey PLUMB-EASY

CHAIR CARRIERS · DRAINS · INTERCEPTORS · HYDROTROLS

THIS NEW VACUUM HEATING PUMP IS SIZED TO ACTUAL JOB REQUIREMENTS



It's the Nash CSM

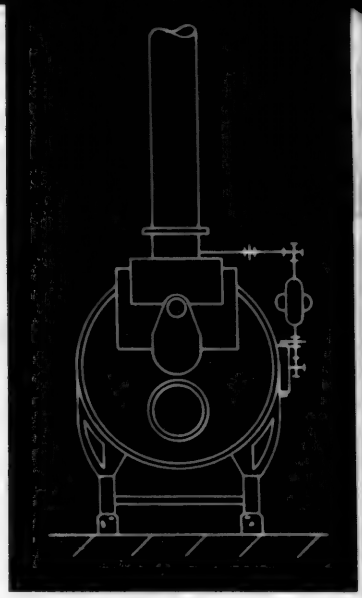
No longer is it necessary for the Engineer to accept a vacuum heating pump with air and water capacities based inflexibly upon square feet of equivalent direct radiation. With the flexible Nash CSM he can provide for proper air capacity in accordance with his judgment and experience. For the individual capacities of the separate pumps on the CSM may be varied within a wide range, without buying an oversize receiver and oversize water pumps.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low, returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY
438 WILSON, SO. NORWALK, CONN.

How to plan a
Boiler Room Layout



C. J. PURTELL and TOM TIMM
Senior Sales Engineers, Cleaver-Brooks Company
Milwaukee, Wisconsin

A practical guide for finding optimum boiler room length, width and height, and for sizing the air supply and the vent stack.

INSTALLATION OF ANY BOILER should be preceded by careful, advance planning so that boiler room equipment will be arranged in the most efficient and convenient way. A little thought and study at the planning stage will pay many dividends in the long run.

As a general rule, accessory equipment will be required along with the boiler. This should be arranged so as to minimize the space requirements and, at the same time, provide adequate facilities for maintenance of the equipment. It must also be remembered that the boiler room itself generally will have a longer life than any equipment housed therein. For this reason alone, provisions should be made in advance for any possible future expansion.

It is advisable to secure equipment dimensions or templates from the manufacturer that will serve as guides in laying out the boiler room. Most manufacturers' catalogs will provide this information.

The following areas should be checked:

(1) *Headroom.* If sufficient headroom is provided, many pipes can be elevated, thereby leaving valuable floor space for other use.

(2) *Aisle space to allow room for maintenance.* Aisle space should be ample, not only for appearance but for the efficient operation and maintenance of the unit.

(3) *Tube removal space.* Tube removal space can be minimized if a door or window can be utilized for this purpose. Note, however, that some boilers do not have provisions for both front and rear tube removal and must be arranged accordingly.

(4) *Future equipment.* Future expansion of a boiler room will be simplified if the present area is on the perimeter of the building. A simple rearrangement of the perimeter would allow the room to be expanded.

Other points to be considered at the planning stage include: fresh air supply, breeching and stack, relief valve outlet to atmosphere, and fuel supply. Planning

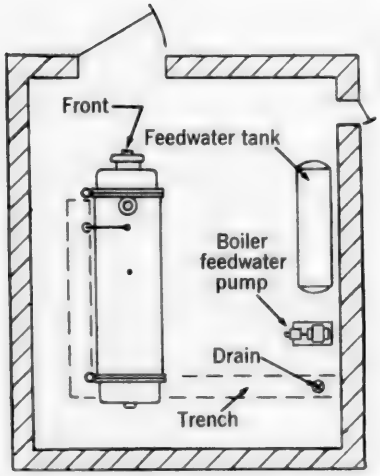


Fig. 1. Shortest boiler room length presumes available door for tube replacement.

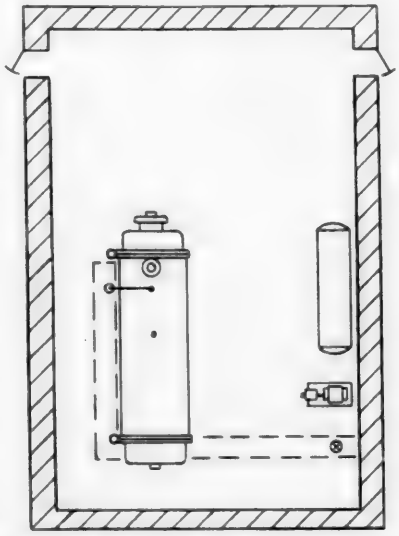


Fig. 2. Layout here presumes tube replacement from the front of the boiler.

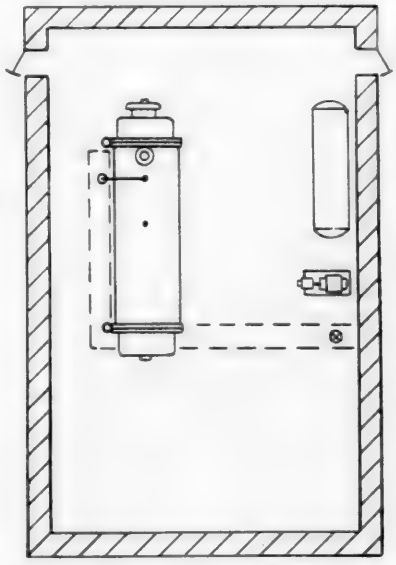


Fig. 3. Slightly longer room is needed if tubes are to be replaced from the rear.

PURTELL

TIMM

Clement J. Purtell, a registered professional engineer in Wisconsin since 1950, and senior sales engineer for Cleaver-Brooks' fire tube boiler division since 1954, received his B.S.M.E. from Marquette University in 1944. He is a member of Sigma Phi Delta and a former member of ASRE.

Tom Timm, also a C-B senior sales engineer, received his B.S.M.E. from Purdue University in 1950 and his Wisconsin P.E. license earlier this year. Before joining C-B, he was senior plant layout engineer for Caterpillar Tractor Company's plant in Milwaukee.

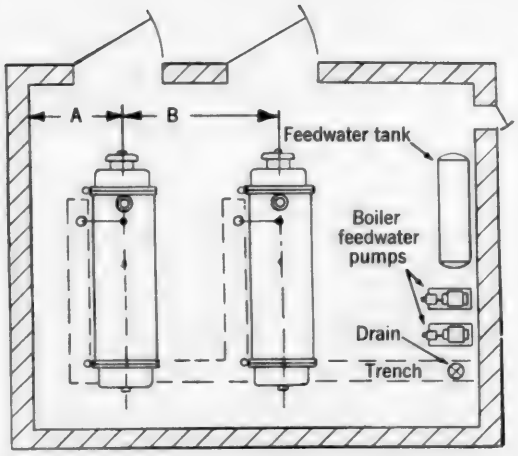


Fig. 4. Minimum distances between boiler and wall (A) and between two boilers (B).

will be made easier by using a step-by-step procedure to check the following points:

Boiler Room Length

Shortest boiler room length (Fig. 1) is obtained by allowing for possible future tube replacement (from front or rear of boiler) through a window or doorway. Allowance is made for only minimum door swing at each end of the boiler. This arrangement provides sufficient aisle space at the front of the boiler but a "tight" space condition at the rear. If space permits, approximately 1½ additional feet should be allowed at the rear for additional aisle and working space.

Next shortest boiler room length (Fig. 2) is obtained by allowing for possible future tube replacement from the front of the boiler. Allowance is made only for minimum door swing at the rear. Here, also, if space permits, approximately 1½ additional feet should be allowed at the rear for additional aisle and working space.

A slightly longer boiler room (Fig. 3) is obtained by allowing for possible future tube replacement from the rear of the boiler. Allowance for door swing at the front provides sufficient aisle and working space at the front.

Boiler Room Width

The minimum distance recommended between the boiler and wall, and between two boilers is indicated in Fig. 4. Dimension *A* allows for a clear 3½-ft aisle between the water column on the boiler and the wall. If space permits, this aisle should be widened.

Dimension *B* between the boilers allows for a clear aisle of 3½ ft, on typical packaged boilers of 15-200 boiler horsepower, 4 ft for 250-350 Bhp, and 5 ft on 400-600 Bhp. If space permits, this aisle, too, should be widened.

Boiler Room Height

No general rule or dimension can be given for boiler room height because it varies directly with: (1) horsepower, size, and height of boilers from the floor line; (2) breeching size and location; (3) steam header size and location; and (4) local and insurance code requirements.

Use the boiler template section for layout guidance for maximum height of the boiler. Add 6 inches to this figure to allow for the height of recommended mounting piers (Fig. 5).

The piers will provide easier access for inspecting piping beneath the boiler and for washing down the floor.

Boiler Room Air Supply

1. *Size and location of air supply openings* in the boiler room can be determined on the following basis:

Two permanent air supply openings in the outer walls of the boiler room are recommended. Locate at each end of the boiler room, preferably below a height of 7 ft. This allows air to sweep the length of the boiler.

Air supply openings can be louvered for weather protection, but they should not be covered with fine mesh wire, since this type of covering has poor air flow qualities and is subject to clogging by dust or dirt.

A vent fan in the boiler room is not recommended as it could create vacuum under certain conditions and cause variations in the quantity of combustion air, resulting in unsatisfactory burner performance.

Under no condition should the total area of the air supply openings be less than 1 sq ft. Size the openings by using the formula: Area in square feet = cfm/fpm.

2. *Amount of air required (cfm).*

   a. Combustion air—maximum Bhp × 8 cfm/Bhp.

   b. Ventilation air—maximum Bhp × 2 cfm/Bhp.

This is a total of 10 cfm/Bhp up to 1000 ft elevation. Add 3% more per 1000 ft of added elevation.

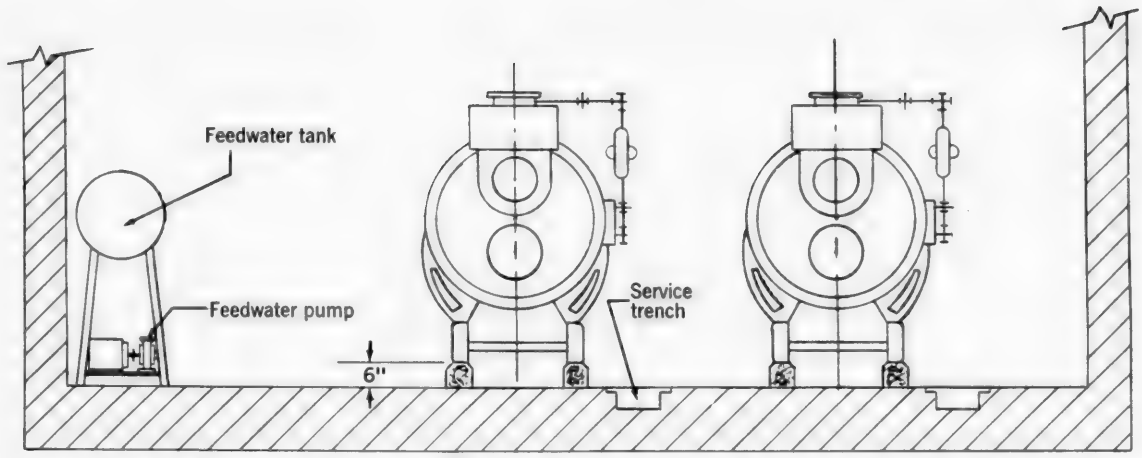


Fig. 5. Use boiler template supplied by manufacturer for guidance in finding boiler room height. Add 6 inches, as shown, for recommended mounting piers.

3. *Acceptable air velocity in boiler room (fpm).*
   a. From floor to 7-ft height— 250 fpm.
   b. Above 7-ft height— 500 fpm.
   c. Duct from air supply to boiler—1,000 fpm.

Example: Determine the area of the boiler room air supply openings for one 300-Bhp boiler at 800 ft altitude. The air openings are to be 5 ft above floor level.

1. Air required: 300 × 10 = 3000 cfm.
2. Air velocity: up to 7 ft = 250 fpm.
3. Area required = cfm/fpm = 3000/250 = 12 sq ft.
4. Area/opening: 12/2 = 6 sq ft per opening. Two openings are required.

Stacks

The only purpose of a vent stack on packaged boilers with forced draft is to conduct the products of combustion to a point of safe discharge. Thus, the need for a stack designed to create a draft is eliminated.

Stack diameter should be the same as the boiler vent outlet. On multiple boiler installations, if building conditions permit, the simplest and most efficient method of venting the flue gas is to use individual stacks.

Minimum 12-gage steel is recommended for stack sections. If the stack will be inaccessible, the use of a non-corrosive material (*e.g.*, glass lining) should be considered. A rain cap or hood should be used at the top of the stack. An offset-type stack connection to the stub vent on the boiler is preferred and recommended (Fig. 6). A direct vertical connection can also be made if required.

Condensation in the stack will vary with the type of fuel and the stack gas temperature. Normally, temperature of the flue gas leaving the boiler will be

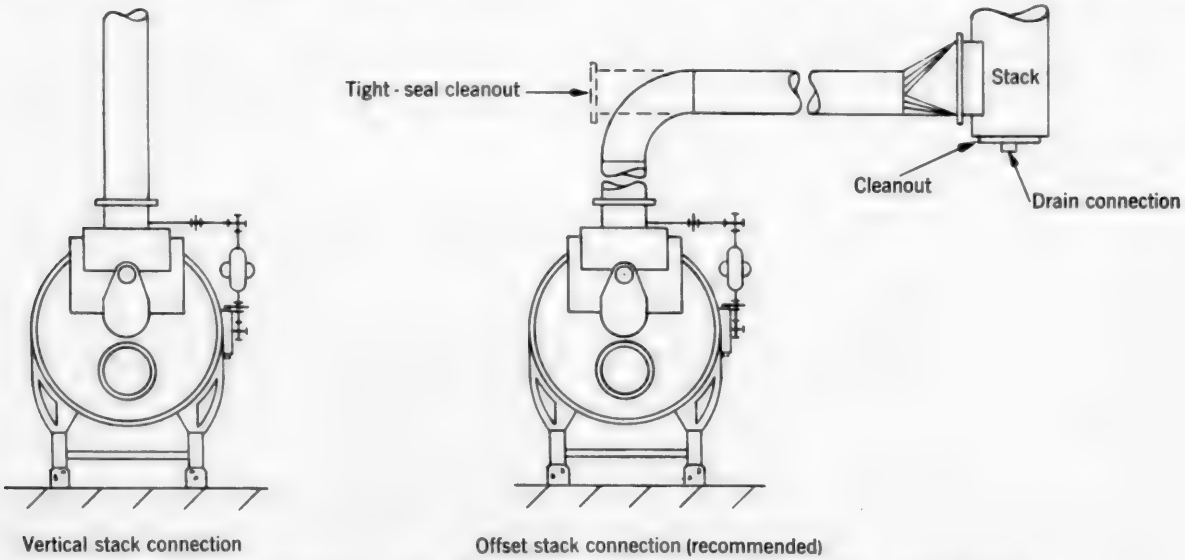
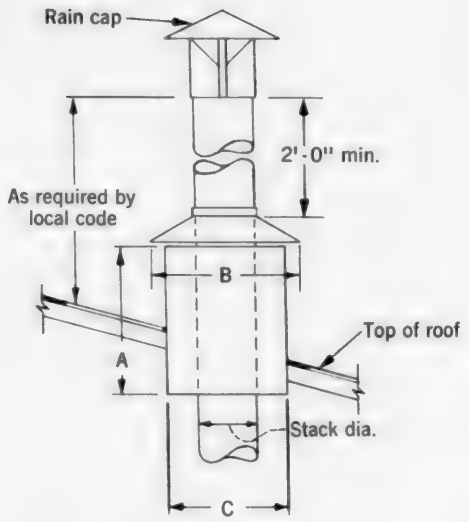


Fig. 6. An offset-type stack connection, as shown at right, is preferred. Direct vertical connection, as at left, may be used if required.

Fig. 7. Typical stack construction. Dimensions (A), (B), and (C) would vary, as follows:

Bhp	Stack Dia	A	B	C
15-20	6 in.	15 in.	15 in.	12 in.
30-40	8	20	20	16
50-60	10	25	25	20
70-100	12	30	30	24
125-200	16	40	40	32
250-350	20	50	50	40
400-600	24	60	60	48



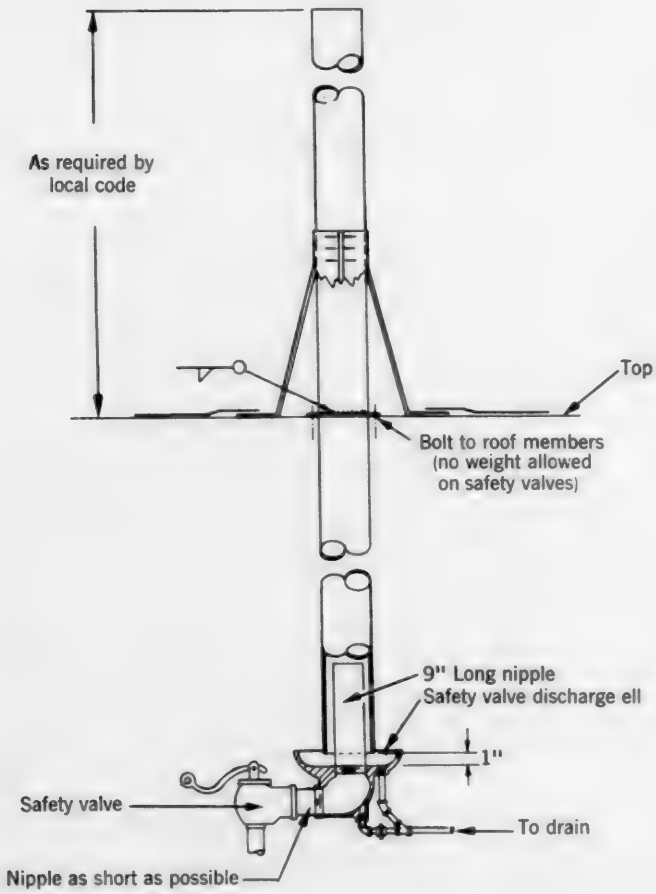


Fig. 8. Guide to safety valve discharge piping, for high pressure boilers.

approximately 125 deg F higher than the temperature of the steam or water in the boiler.

Stack condensation is most likely to occur on heating boiler installations where light loads and intermittent firing cause a cool stack condition which results in condensation of the water vapor in the flue gas. The condensed water accelerates corrosion of steel stacks or breechings.

To minimize stack condensation:

1. Size the boiler as close as possible to the true heat load. Avoid oversizing.

2. Bear in mind that masonry stacks have better heat holding characteristics than steel stacks.

3. If steel stacks are used, insulate them to minimize heat loss.

4. If possible, use an offset stack with bottom cleanout and drain connection to prevent any condensed water from draining back into the boiler.

Boiler vent outlets will withstand a maximum direct vertical load of 2,000 lb. This loading must include the effect of wind and guy wires. A typical stack construction is shown in Fig. 7.

Safety Valve Discharge Piping

For high pressure boilers, the sketch in Fig. 8 may be used as a guide for safety valve discharge piping.

For full boiler room layout, see this month's blue detail sheet.

SELECTING CONTROLS
for High Velocity Double Duct Units

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Field Engineer
Johnson Service Co., Milwaukee, Wis.

The first step in applying controls to double duct mixing units is sound pre-design analysis, says the author. Here, he describes advantages and disadvantages of various control arrangements, and applies each arrangement to zones or rooms of a generalized floor plan.

SEVERAL CONTROL ARRANGEMENTS ARE USED for individual high velocity double duct mixing units. The control arrangement used for any unit depends largely upon the type of control desired and the use of the controlled space the unit serves.

Arrangements Described

In the arrangement shown in Fig. 1, a room thermostat controls the high velocity mixing unit. Pressure in the hot and cold supply ducts is not controlled. Therefore, the pressure at any unit depends on the two factors of static head available from the fan and the friction losses in the ductwork, which vary with velocity in the duct.

The room thermostat controls both the hot and the cold air valves, one normally open, the other normally closed. Both the flow of air from the unit and the noise level fluctuate with duct pressure changes.

Figure 2 is the same as Fig. 1, except that static pressure of air supplied to the units is controlled either at the fan or in the ductwork to the units. The pressure measuring tips must be located carefully to accurately measure representative duct pressures. Improper location may cause varying pressures in the ducts.

As long as the load remains fairly constant, as is true of interior zones, this arrangement provides relatively constant air flow and delivery. However, air delivery from the individual units will vary widely if large load changes occur or if heating or cooling design conditions vary widely among the rooms.

For example, if pressure is controlled in a duct supplying 15 mixing units, the air delivery for these units may be balanced for a particular static pressure setting at the duct controller. If 12 of the 15 mixing units require cold air and the remaining three require warm air, there will be little pressure drop in the warm air duct. The total pressure drop through the hot duct will be taken through these three units. The excess delivery caused by this pressure will probably cause increased noise level.

In the arrangement shown in Fig. 3, the room thermostat controls temperature and the volume of air delivered by the unit is controlled by a flow controller.

This arrangement provides constant volume control at the individual units. It is not necessary to control pressure in the ducts supplying the units. Balancing air delivery in the supply ducts is also eliminated.

The arrangement has this limitation: If the flow controller has the cold valve completely closed, and flow through the hot air valve still exceeds the desired quantity, volume control is lost. This rarely occurs, however, except during start up or when any unit is delivering only hot air to meet full design heat output. And even then, the duct pressure usually is low enough to avoid trouble.

For example, if the mixing units on a given zone duct takeoff call for full cooling, the flow in the hot duct decreases, causing a decrease in friction loss in this duct and an accompanying increase in static pressure. If the load on one unit on this duct changes to require heating, this unit will deliver an excessive amount of air. A control arrangement that avoids this condition is shown in Fig. 4.

In Fig. 4, an automatic pressure selector has been added to the arrangement of Fig. 3. This enables the flow controller to override the room thermostat when the cold air valve is completely closed and the volume delivered still exceeds the desired volume. When the flow controller overrides the thermostat, it partially closes the hot air valve to dampen volume. Units with mechanical or self-contained constant volume control apparatus provide constant volume control similar to that described for Fig. 4.

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CONTROL POSSIBILITIES:

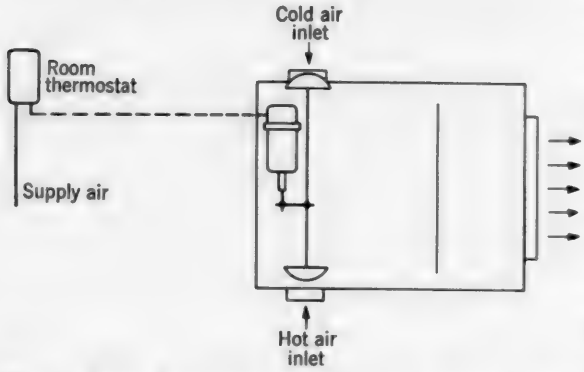


Fig. 1. Room thermostat controls high velocity mixing unit; pressure in hot and cold supply ducts is not controlled and unit pressure can vary.

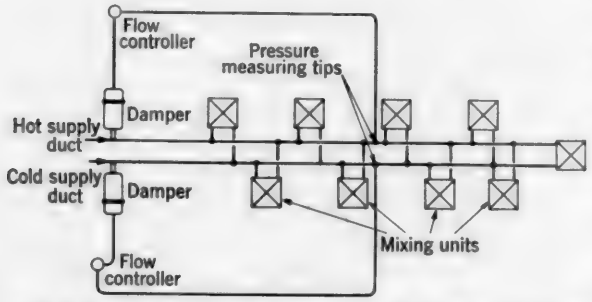


Fig. 2. Control of static pressure of air supplied to units has been added to arrangement of Fig. 1.

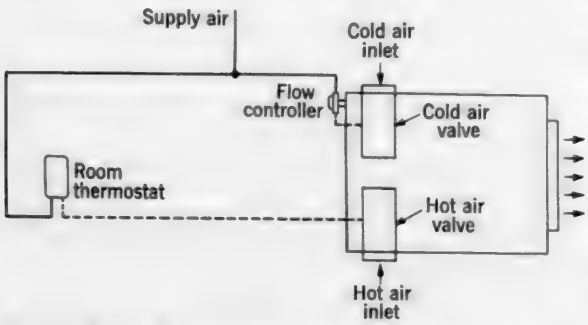


Fig. 3. Room thermostat controls temperature; volume of air delivered by unit is regulated by flow controller.

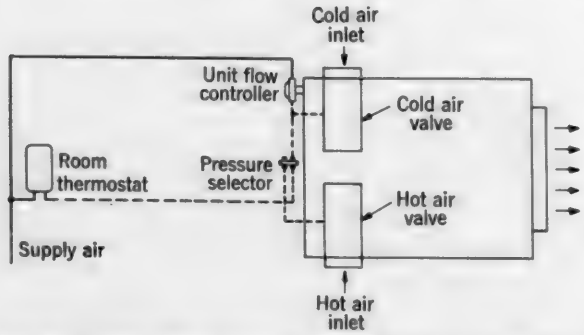


Fig. 4. Automatic pressure selector has been added to control arrangement of Fig. 3.

This type of arrangement should be required only when noise level design and volume design conditions are critical. In other words, it should be reserved for areas in which occasional slight changes in noise level or volume are objectionable.

Application

As an example of the use of the control arrangements described above, consider the floor plan layout shown in Fig. 5. This could be the floor plan of a small office building or a single floor of a multistory building. An analysis of such a layout should be the first step in applying proper control to high velocity double duct systems.

The duct layout in Fig. 5 for Zones 1 and 2 assumes that the ductwork starts at a maximum size at the fan and gets smaller toward the ends of the runs. It may be economical, however, to design the ducts same-size for the full length of run to take advantage of static regain, and connect them together in the northeast corner of the building. So connecting the ducts would be an aid to proper distribution of hot and cold air, since these zones have different exposures and will require hot or cold air at different times. For example, any excess of hot or cold air not used by one zone would be available to the other, if required.

For purposes of the following control analysis, however, assume the duct to be as shown in Fig. 5.

The high pressure supply fan is located in the equipment room, Room 12. In multistory buildings, the hot and cold air risers usually feed into such a room. The high pressure ductwork in Fig. 5 is shown as a single line coded to differentiate between hot and cold air supply ducts.

The high pressure ductwork is divided to serve three zones. Zone 1 is the north and east exposures. Zone 2 is the south and west exposures. Zone 3 includes the interior rooms and areas.

Both the high pressure ductwork and the mixing units are located in the furred space above the ceilings. All spaces in Zone 1, except Room 9, utilize mixing units which have ceiling diffusers attached to the unit and discharge air directly into the room. Octopus type units with flexible ductwork connecting the unit to the ceiling outlets are used in Room 9.

One of the first things to analyze before designing the control system is the use of the room to be controlled. Room 1 is a reception and switchboard room. Room 2 houses a secretarial pool and Rooms 3 through 7 are individual executive offices. Room 8 is a storage space and Room 9 is a general office-services area including typing facilities and office machinery, and attendant personnel. Rooms 10 and 11, and 13 through 17 are general purpose office areas, all of which have high occupancy.

Zone 1

Rooms 10, 11 and 13 are areas of low background noises where a low noise level and uniform air distribution are desirable. However, since these rooms are very close to the supply fan where friction losses

are low, static pressure at the units should be nearly constant; automatic constant volume control should not be required. Controlling these units with room thermostats only, as shown in Fig. 1, should be sufficient.

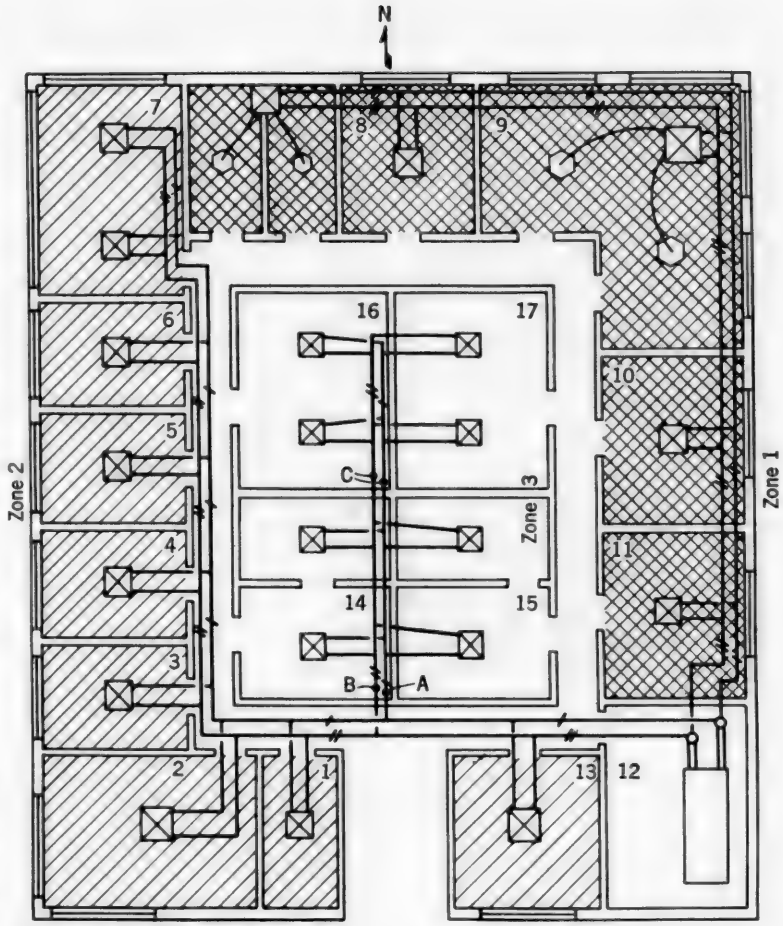
Control of room temperature alone in Room 9 is sufficient. Although this room has a high heat gain from bookkeeping and duplicating machines and other heat generating office equipment, the noise level is relatively high. Slight changes in duct pressure will make very little difference and volume control is not necessary. The arrangement shown in Fig. 1 should be used in this room too.

Storage room, Room 8, and the two adjacent areas should also be controlled by a room thermostat only.

Zone 2

In Zone 2, all rooms including Room 1 should be provided with automatic constant volume control to maintain a constant low noise level since this is a relatively quiet area. Constant volume control as shown in Fig. 3 should be used for Room 1.

Room 2 is affected by sun load and in the afternoon has direct sunlight through the large glass area. During this period, large volumes of cold air are required. Control by thermostat only would cause unnecessarily high noise levels. Constant volume control, as shown in Fig. 3, should also be used here.



ROOM NO.	USE
1	Reception room
2	Secretarial pool
3 to 7	Executive office
8	Storage
9	Typing and office machinery
10 to 17	General office

Fig. 5. An analysis of this typical floor plan layout helps to determine most suitable control arrangement for each area.

Constant volume control as shown in Fig. 4 is not required, since Rooms 1 and 2 are comparatively close to the supply fan where duct pressures do not vary widely. With south exposure, Rooms 1 and 2 should not require heating when most of the other rooms require cooling and hot duct pressures are high.

Units in private offices Rooms 3 through 7 should have positive constant volume control as shown in Fig 4. This is desirable for instances when most of the building is requiring cold air, as in the morning, when the sun load is on the east side of the building. The west side, because it has no sun load and has very low occupancy, could require warm air. Because these rooms are individual executive offices, usually occupied by only one person, and require that background noise is very low, they are probably the most critical areas in the building.

Zone 3

The rooms of Zone 3 would have a relatively constant load level. Because these rooms are located in the interior areas of the building, they are not affected by solar gains or other ouside design influences. The control arrangement shown in Fig. 2 could be used for this entire zone. Some means of throttling or regulating the air flow should be provided at Points A and B (Fig. 5) in the hot and cold ducts. Two flow controllers should be used, with their measuring tips located at Point C to control the dampers at Points A and B.

The above analysis may seem to be too simple an approach to a rather complex problem. Experience has shown, however, that it is a needed approach. More often than not, it means the difference between unsatisfactory control and superior control of high pressure double duct mixing boxes.

Selecting Centrifugal Pumps

For Air Conditioning Applications

HENRY M. POLLAK
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Ingersoll-Rand Company

In this, the first of a series of four articles, the author has reduced the problem of selecting pumps to its elements in a surprisingly easy-to-read (and digest) article which, nevertheless, thoroughly covers the subject.

CIRCULATING PUMPS for heating and air conditioning can be a relatively small item in the construction and fitting of a building. As a result, many engineers tend to select a pump from convenient catalogs rather than to go to the trouble of specifying the precise requirements of the system. As long as the pumps run trouble-free, the engineer feels he has done a good job. Yet, there is just as much reason why pumping requirements of a building should be precisely determined as the heating or cooling requirements.

The problem of pump selection can even be critical, as, for example, in an industrial application. Here, the difference between adequate pumping and good pumping can exert a substantial influence on the annual balance sheet. The major problem facing the engineer is to select the "one" best pump out of a maze of types, sizes and features offered by various pump manufacturers.

Do you feel the difference between two pumps is insignificant? Consider two small pumps, both 70 foot heads at 200 gpm with a motor efficiency of 85%. The difference between the two units is that one pumps at 80% efficiency and the other pumps at 60% efficiency. The first will draw 3.9 kw and the second 5.2 kw, a difference of 1.3 kw. At one cent a kilowatt an hour, the cost of excess electricity is $93 a year for 300 operating days. Over the 10-year life of the unit this comes to about $930. *The difference in operating costs in a 4- or 5-pump central heating and air conditioning plant would be $3,700 to $4,600 over a 10-year period!* Insignificant?

Centrifugal pumps will handle the vast majority of liquid moving problems that face a heating and air conditioning engineer. Centrifugals are less expensive initially, more efficient, less costly to operate, less costly to maintain and can pump liquids that are impossible to handle with rotary or reciprocating pumps. Liquids handled by centrifugals can be clean and clear, dirty and abrasive or even contain high percentages of solids.

Positive displacement pumps, rotary, gear or reciprocating, are often required when the unit must be self-purging, must work with high suctions, handle large amounts of entrained air or vapor or pump highly viscous fluids. Even these areas are not exclusively the territory of positive displacement pumps. Specially designed centrifugal pumps that are self-priming and self-venting can handle substantial amounts of entrained air and vapor.

There are relatively few instances of pumps being undersized since it is of primary importance that pumps deliver the fluid at whatever flow rate and pressure is required. The tendency is, instead, to over-size. This can be costly. At the least, you can wind up paying more for the pump and pumping than is necessary. Even worse, an additional safety factor can cause the drive motor to overload and burn out.

Every piping layout has some sort of system curve such as shown in Fig. 2. The system curve is a means of determining the head required to obtain a specified rate of flow. In the system curve shown, 170 gpm will be delivered if a 100-ft head is applied to the system. Consider what occurs when someone specifies a 200-ft head, "just to be on the safe side". From Fig. 3, a certain model of pump with a 7-inch impeller would deliver 170 gpm at a 200-ft head. Interpolating between the brake horsepower lines, this head and impeller would require approximately 13 BHP. Therefore, a 15-hp motor should be more than adequate.

However, observe what happens when this impeller curve is superimposed on the system curve, Fig. 2. The pump continues pumping until its curve and the system curve intersect, and delivers 260 gpm at a head of 185 feet, not 170 gpm at a 200-ft head. This condition requires (see Fig. 3) between 16 and 17 brake horsepower—quite possibly causing the 15 bhp motor to burn out. This error is particularly dangerous when using explosion-proof and totally-enclosed drivers as there is no safety factor available in the motor.

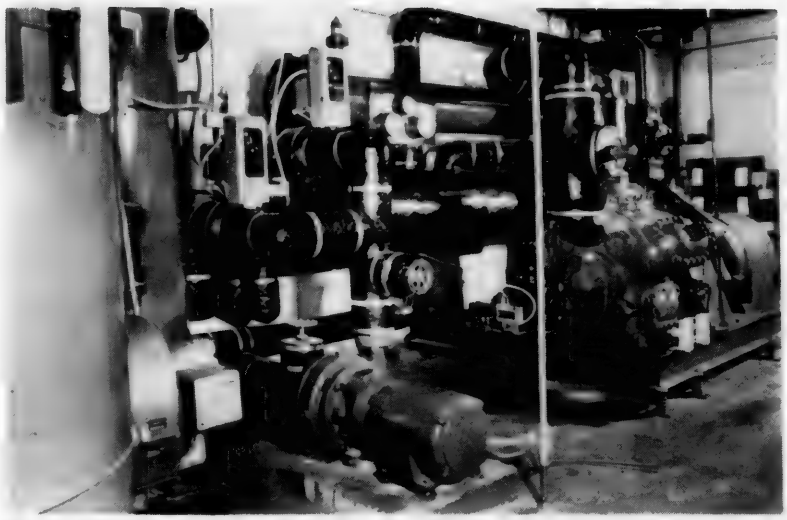

Fig. 1. Circulating pumps for centralized heating and air conditioning may be relatively small as in this installation in a modern Florida motor lodge. On the other hand, they can represent a substantial investment in capital equipment and operating costs.

Comparing Pumps

One of the major problems is to avoid being confused by the many different pumps recommended by various manufacturers. Regardless of what a centrifugal pump looks like, it can be reduced to certain fundamentals for the basis of hydraulic comparison:

(1) Specific speed
(2) Efficiency
(3) Driven speed, and
(4) Suction conditions.

Specific Speed

Hydraulically, centrifugal pumps are classified by specific speed. Centrifugal pumps can be compared on the basis of specific speed regardless of the relative sizes of the individual pumps. The specific speed[1] of a pump is merely a designer's device that relates the capacity and the head of a pump at its most efficient point.

Specific speed of a pump is not normally supplied by the pump manufacturer, but can be determined with the aid of Fig. 4. First, determine the pump capacity and the head at its *most* efficient point. Locate capacity on bottom horizontal scale and the head on the vertical scale. Read up and over, respectively, to determine the point of intersection. The number on the diagonal line at the point of intersection is the specific speed.

Efficiency

It was previously pointed out that efficiency can have an appreciable effect on operating cost. However, there is still another important reason why you should be concerned with efficiency—noise level. Flow patterns in a hydraulically noisy pump contain eddies, separations, vortices, mismatched hydraulic passages, etc. These conditions also describe the most common culprits in low efficiency pumps. Efficiency, then, is frequently indicative of the comparative noise levels that can be expected from centrifugal pumps.

Fig. 5 may be used as a guide for determining peak pump efficiency for a given capacity and specific speed. Locate the rated capacity in gpm on the bottom scale. Read vertically to the intersection of the specific speed curve of the pump. Read horizontally to the vertical scale on the left to obtain an average peak efficiency accurate to ± 5%. Fig. 5 is based on vertically-split, end-suction pumps. Efficiencies for horizontally-split, double-suction pumps will tend to be slightly higher in large, high specific speed units and slightly lower for smaller low specific speed pumps.

Careful consideration should be given in comparison of efficiencies. Many of the standard "extra" features that manufacturers build into their pumps will cause lower efficiencies. Vanes on the back of the impeller (designed to reduce axial loads) are paid for in lost efficiency. Likewise, wearing rings on the back of the impeller (also to reduce axial loading) in combination with balance holes in the impeller will cause a loss in efficiency. Open and semi-open impellers are generally less efficient particularly in the low specific speed ranges. Specifying an open impeller can cost from 3 to 5% points less efficiency than the comparable closed impeller. Special suction shapes and tailored hydraulic passages designed for mechanical advantage often cause efficiency losses.

Thus, when comparing efficien-

[1]It is numerically equal to the (rpm) multiplied by the ($\sqrt{}$gpm) divided by (head in feet).$^{3/4}$

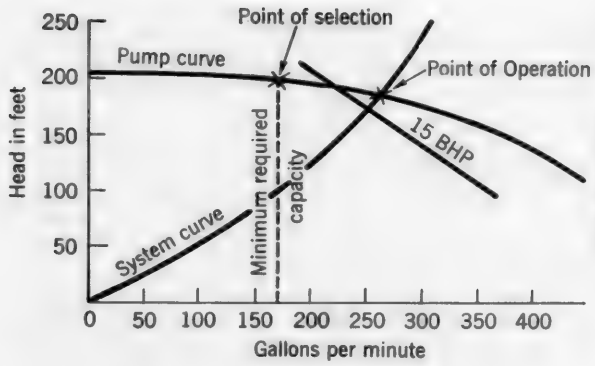

Fig. 2. The system curve is shown here and, superimposed, the pump curve for a particular pump whose characteristics are shown in Fig. 3.

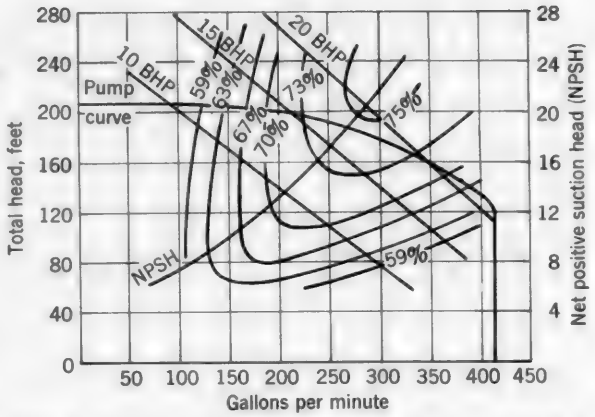

Fig. 3. Performance curve of pump to be applied to system requirements of Fig. 2.

cies from Fig. 5, use the average efficiency obtained from the plot as only a bench mark. Observe the features that will cause additional losses and compare an adjusted average efficiency with the efficiency of the unit you are evaluating.

Finally, it must be observed that the maximum efficiency of a centrifugal pump is not the lone absolute criterion for evaluation of efficiency. This is particularly true in the case of units that will operate at more than one condition in such service as centralized air conditioning with separate controls for various components.

Almost as important, as a general rule, and quite often more important, in specific cases, is the flatness of the efficiency curve. If one were to compare two efficiency curves plotted versus capacity, as shown in Fig. 6, it should be noted that, although curve *A* has a considerably higher maximum efficiency than Curve *B*, the efficiencies on either side of maximum fall off much more rapidly in the former than in the latter. In general, it is safe to say that, on an overall evaluation,

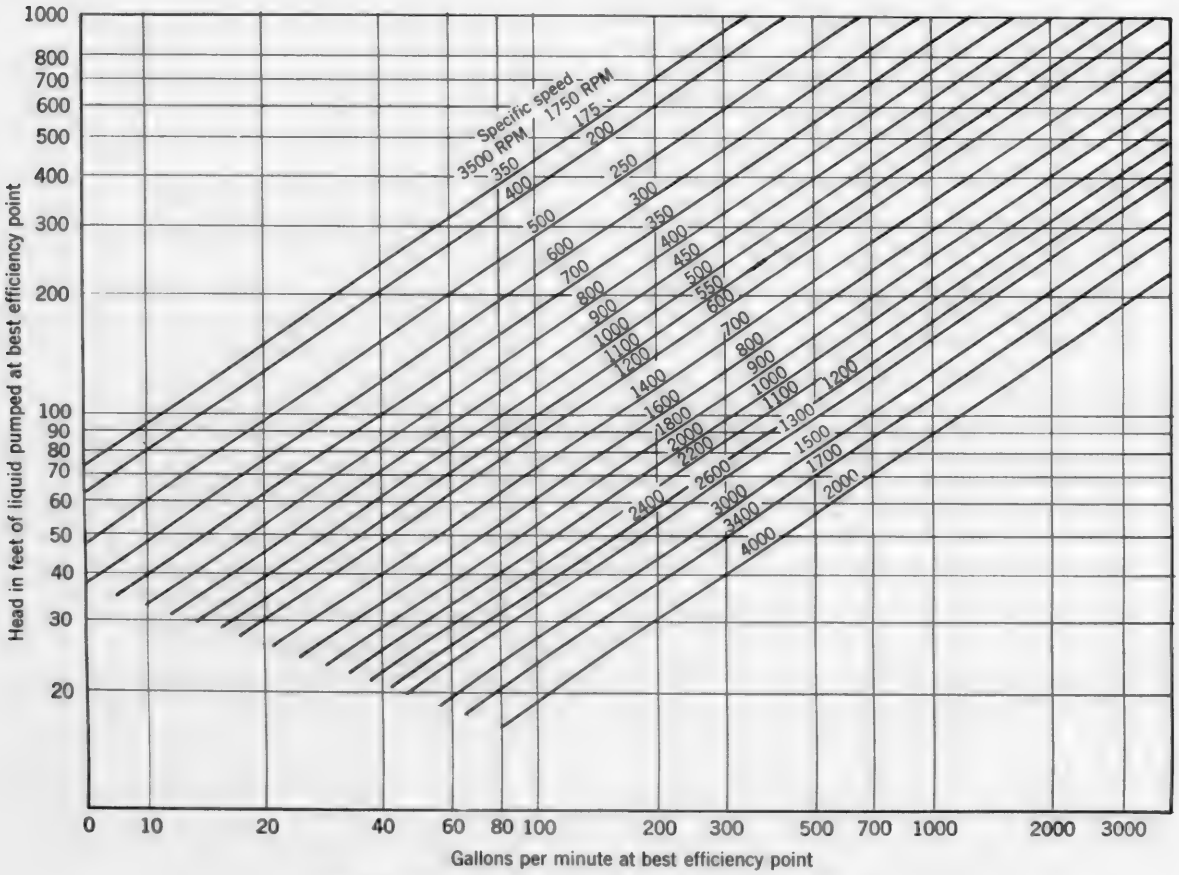

Fig. 4. Chart for determining specific speed of a pump.

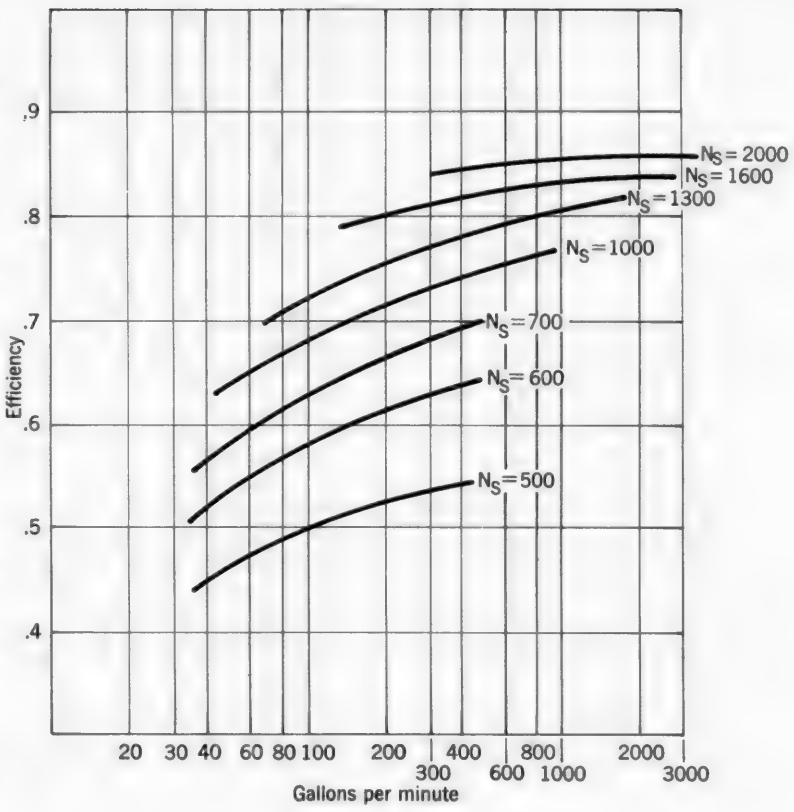

Fig. 5. Guide for determining peak efficiency for a given capacity and specific speed (N_S) for vertically split, end suction, centrifugal pumps offered by three manufacturers.

Curve *B* indicates a more useful product than Curve *A*. In fact, it would be a rare case where a customer's system curve was so accurate and inflexible that he could be sure he was taking advantage of the higher efficiency of curve *A* in the selection of this pumping unit.

Driven Speed

What speed drive is best? The vast majority of pumps used in the air conditioning and heating field will normally be driven by an electric motor. Steam and gas turbines and diesel and gas engines are usually confined to highly specialized applications.

Three speeds are commercially available with 60-cycle a-c induction motors supplied by pump manufacturers. It is almost always wise to select the highest synchronous speed available. Commercially available single-stage centrifugal pumps generally have specific speeds under 3000. Motor speed of 3450 rpm will inherently provide the most efficient unit since specific speed varies directly with the motor speed and efficiencies increase with increasing specific speed (up to approximately 3000 specific speed). In addition, the higher the speed of the pump the smaller and more compact the unit becomes. Pump costs reflect this in that the cost of a high speed unit in dollars per gpm is low.

These advantages can be more clearly shown by comparing two pumps, as in Table 1; pumps have essentially equal hydraulic performance. The 3450 rpm unit has an impeller diameter half as large as the slower unit, requires 25% less horsepower and weighs only 60% as much. Most important, average power requirements of the faster unit are only 80% of those of the slower unit, which means lower operating costs throughout the life of the unit.

Efficiency is not the only criterion in selection of pump speed. There are at least two other factors that may enter into selection. When they do, a lower speed (usually 1750 rpm) unit can often be more advantageous.

First, acceptable noise level might be such as to dictate the use of a slow speed unit. Noise can be reduced in higher speed units by isolating the pump both on its mounting, at its piping connections, and in the space in which it is mounted. If, however, it is suspected that this will not sufficiently reduce the noise, a slower speed unit can be specified. Although hydraulic noises of the higher speed units are of little importance in a well designed, well built pump, driver, bearing, and mechanical noises can often be substantially reduced by using a slower speed unit.

Second, when difficult suction conditions are an important consideration, it is quite reasonable to take advantage of the inherently lower required suction pressure for operation in lower speed units. Here, as in the case of noise level, other, less costly solutions are available and should be investigated before specifying the lower speed.

Table 1. Comparison of Two Hydraulically Equal Pumps with Different Speeds[1]

Pump speed rpm	Max. impeller dia., in.	Max. horsepower req'd	Net weight, lb[2]	Max. efficiency, %	Approx. aver. power input kw.[3]
1750	11	10	445	65	7.5
3450	5½	7½	265	82	6

[1] Approximately 100 feet head at 215 gpm.
[2] Weight for close-coupled motorpump.
[3] When operating at 100 ft., 220 gpm.

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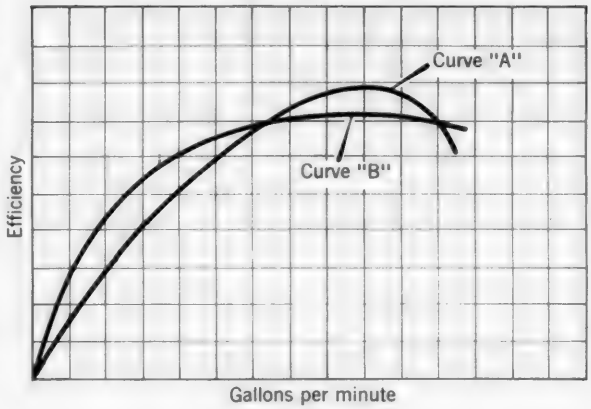

Fig. 6. A pump with a "flat" efficiency curve (B) is probably a better selection than one with a sharper peak (A) even though the maximum efficiency of the latter is higher. See text.

Suction Conditions

Suction conditions are the source of more pump troubles and more incorrectly specified pumping than anything else connected with centrifugal pumps. *All centrifugal pumps must be supplied with some positive pressure* (absolute, not gage) *on the fluid at the entrance to the impeller.* Without sufficient pressure, cavitation occurs, as vapor bubbles, formed at the intake, collapse against the impeller. This collapse creates considerable noise as well as mechanical action and can result in serious pitting and erosion of the impeller. You can prevent these troubles by specifying the suction head (pressure) required by the pump impeller equal to or slightly smaller (lower) than the available system suction head.

Suction head is described by pump manufacturers by a term called net positive suction head or NPSH. There are *two* different NPSH values to consider in the analysis of a system: (1) the NPSH *available* in the system; and (2) the NPSH *required* by the pump to prevent cavitation.

Available NPSH is a function of system layout and the fluid being pumped. Required NPSH is a function of the pump design and is obtainable only from the manufacturer from actual tests conducted on the pump. Required NPSH varies from one pump to another. Figures for one pump are no use whatsoever in calculating conditions for another pump. On the other hand, available NPSH can be easily calculated for a system and is applicable to whatever pump considered.

For the system: Available NPSH = absolute pressure measured at center line of the pump intake—vapor pressure of the liquid being pumped.

For the Pump: Required NPSH $\leq$ Available NPSH

As long as the available NPSH is equal to or slightly greater than required NPSH, there should be no danger of cavitation. Absolute pressure measured with a gage at the pump intake does not include the velocity head. Be sure that the manufacturer's curve showing the required NPSH has taken this quantity into account or make the correction before comparing with available NPSH. Some manufacturers do not include the velocity head in their curves and, on the surface, these pumps would appear to have very low required NPSH. When velocity head is included, some manufacturers show the notation VHA (velocity head added) on their pump curves. By the Hydraulic Institute definition of NPSH, velocity head should be included in the manufacturer's curves.

Exercise a good degree of caution in adding a safety factor, as the addition of a large NPSH safety factor can be just as costly as excess head.

There are two things you can do when available NPSH does not equal the required NPSH. You can select a different pump with a lower required NPSH. This usually means a larger, more expensive pump and motor. Or, you can alter the system design which may or may not be more expensive.

Available NPSH is altered by the suction lift, by vapor pressure of the liquid and suction losses such as friction in the intake piping. Vapor pressure can be reduced by lowering the temperature of the liquid. Most common, and usually the least expensive, is to mount the pump on the cooler side of the system. This can be accomplished in a closed circuit by providing a larger liquid reservoir and/or installing a cooling element. Suction lift can be reduced by locating the pump closer to the level of the liquid supply. Friction losses in the suction piping can be reduced by increasing the piping size or reducing the number of fittings. Weigh the costs involved in changing required or available NPSH carefully before making a decision.

These four factors — specific speed, drive speed, efficiency and suction conditions—tell the hydraulic story of your pumping application and will help you make an intelligent comparison, with subsequent selection, between *similar* pumps of various manufacturers. Hydraulic comparisons should be made only on mechanically similar pumps. Do not compare one manufacturer's single-stage pump versus another's multi-stage pump, or one manufacturer's open impeller versus another's closed impeller. The lowest cost pumping for a specific job can be supplied usually by only one type pump.

Next month, the author will discuss the question of pump impellers.

ESTIMATING

Job Time Reference Data

Part 6 in this series on estimating continues the publication of a group of tables containing specific estimating data in terms of man-hours of labor. Covered this month are installation data for big-building centrifugal pumps and sump pumps.

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FOR GENERAL BUILDING SERVICES, where pumps are needed to handle water, steam or other liquids, the motor-driven centrifugal pump is usually used.

They are generally installed on a concrete foundation which is set on the concrete slab or floor. The bed plate, upon which the pump and motor are set, is attached to the foundation by means of anchor bolts set in the foundation. The bed plate is then grouted and leveled, and the pump and motor lined up.

Union regulations call for the use of riggers, millwrights and electricians to install the pumps and motors and do any work necessary to put this equipment in running condition.

Table 16, next page, gives the size, capacity, total head in feet, size of motor, weights, and the number of manhours required for the various trades to install this type of equipment. Shown also are the amounts in cubic yards of concrete required for the foundations, and the amounts in square feet of grouting required to set the bed plates.

Sump Pumps

Generally, with the exception of most private dwellings, there is need for some type of sump pump in the average plumbing job.

In jobs where some of the drain lines are located below the level of the street sewer or sewage disposal system, it is necessary to install a sump pit to receive the waste matter. These pits are usually constructed of concrete, cast iron or steel.

The waste matter is then lifted out of the sump pit or sump basin by means of a sump pump which pumps the waste matter up into the house sewer.

This type of pump is motor driven and is equipped with a suction piece which extends to within a few inches of the bottom of the pit or basin. A metal cover is provided to fit the top of the pit or basin, having the necessary openings to receive the pump. The pump is then bolted to the cover and connected to the piping discharging into the house sewer.

Table 17, next page, covering the installation of general service and non-clog types of sump pumps, gives size, capacity, total head in feet, motor size and weights; also, the total manhours for the trades involved to install single or duplex pumps for this type of service.

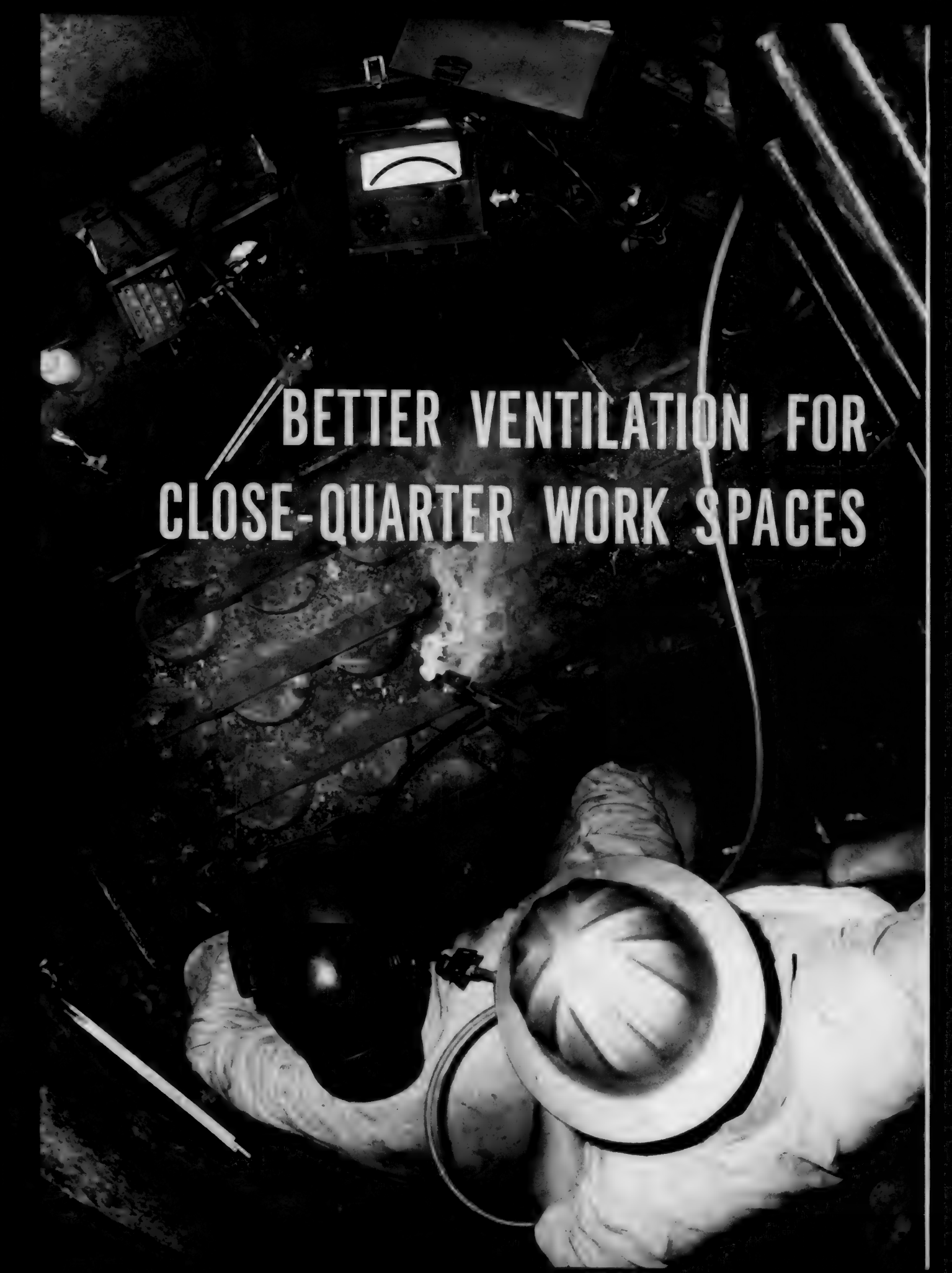
TABLE 16—GENERAL SERVICE CENTRIFUGAL PUMPS—INSTALLATION

Pump Suction, Size in Inches	Gal. per Min.	Total Head in Feet	Motor Horse-power	Weight Pump and Motor, Pounds	Grout in Sq. Ft.	Time in Man-Hours			
						Riggers	Millwright	Electrician	Total
1¼	10	100	1	415	15	10.5	3.0	3.5	17.0
1¼	20	100	1½	500	15	11.0	3.0	4.0	18.0
1¼	30	100	2	500	15	11.0	3.0	4.3	18.3
1¼	40	100	5	550	15	16.0	4.3	5.0	25.3
1½	50	125	5	750	15	16.5	4.5	5.8	26.8
1½	60	125	5	750	15	16.5	4.5	5.8	26.8
2	80	125	7½	750	15	16.5	4.5	5.8	26.8
2½	100	125	7½	800	15	17.5	4.8	8.5	30.8
2½	125	125	10	800	15	17.5	4.8	8.5	30.8
2½	150	150	15	1050	15	22.0	6.0	10.3	38.3
2½	200	150	20	1050	20	22.0	6.0	13.0	41.0
2½	300	130	25	1140	20	25.0	6.9	13.0	44.9
3	500	150	40	1485	23	33.0	8.9	15.0	56.9
4	700	150	50	1760	23	39.0	10.8	27.0	76.8
5	900	150	60	1805	23	40.0	10.8	27.0	77.8
6	1200	150	70	2695	26	43.0	16.5	27.0	87.0
6	1400	175	75	2830	26	46.0	17.0	48.0	111.0
6	1600	150	100	2830	26	46.0	17.0	48.0	111.0
6	2000	150	150	3105	26	49.0	18.5	56.0	124.0
10	3000	150	200	4810	36	72.0	29.0	60.0	161.0
10	4000	150	250	5120	36	78.0	31.0	77.0	186.0
12	5000	150	300	5960	42	84.0	35.0	90.0	209.0

TABLE 17—SUMP PUMPS—INSTALLATION

Type of Pump	Size of Pump, Inches	Gallons per Minute	Total Head in Feet	Motor Horse-Power	Motor Speed, RPM	Shipping Weight Pump & Motor For 6'-0" Depth, Incl. Cover, in Pounds		Add'l Weight for each Add'l 6'-0" of Depth, in Pounds		Time in Man-Hours for Pump & Motor Installation	
						Single	Duplex	Single	Duplex	Single	Duplex
General Service	1½	30	30	¾	1750	343	670	55	110	18	28
	1½	50	30	1	1750	393	770	60	120	18	31
	2	50	40	1	1750	442	940	81	162	20	38
	2½	75	30	1	1750	508	980	90	180	20	40
	2½	75	60	3	1750	628	1272	100	200	25	51
	3	100	50	3	1750	775	1422	110	220	31	56
Non-Clog	3	100	40	3	1150	835	1542	155	310	33	60
	4	150	50	5	1150	945	1770	200	400	38	71
	4	200	40	5	860	960	1880	250	500	39	75
	6	750	30	10	1150	1685	3170	300	600	67	127
	6	500	40	7½	860	1985	3770	370	740	79	151
	8	1500	40	25	860	3340	6200	600	1200	134	215
	10	2500	50	50	860	5120	9670	700	1400	204	340
	14	4000	30	40	680	7100	13000	1200	2400	284	460

Next month, Job Time Reference Data will cover the application of insulation to piping and allied equipment.


BETTER VENTILATION FOR
CLOSE-QUARTER WORK SPACES

Better Ventilation for Close-Quarter Work Spaces

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As the result of a long range study of fume and heat outputs in closely confined spaces, the authors have developed a nomogram for determining the ventilation rate for welding processes; reached basic conclusions regarding ventilation pattern, direction, and velocity; and developed rules for ventilation where heat, rather than fume, is the controlling variable.

CONTROL OF ATMOSPHERIC CONTAMINANTS in the worker's environment, when work is performed in confined spaces, represents a most critical area of ventilation. When an operation is surrounded by walls or obstructions, or is completely enclosed within a tank or tower, air movement is restricted and potential exposures to dust, fume, gases and heat are greatly enhanced. Most exposures are not acute in the sense that there is a demanding need for control to prevent outright collapse. But even at the lower levels of exposure, environmental factors may be directly responsible for uncomfortable or undesirable conditions leading to undue fatigue and a reduction in the quality and quantity of work output.

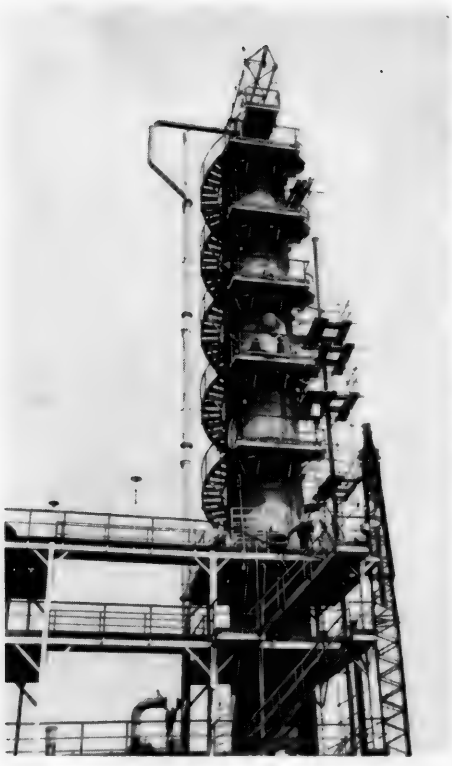
In the petroleum and chemical industries considerable enclosed vessel work is required in equipment such as fractionation towers, drums and tanks. Exposures may exist during construction but are potentially more severe during maintenance, after the unit has handled toxic materials. Industrial hygiene surveys have shown that improved control of environmental conditions in such confined spaces would be beneficial.

In the affiliated companies of Standard Oil Co. (N. J.) a high degree of interest in improved confined space working conditions was expressed by the various medical, operating and mechanical departments. For this reason, a research project was formulated to develop optimum methods for ventilating distillation towers in which welding and cutting operations were being performed. This type of vessel work represents a large man-hour expenditure in a refinery and therefore was chosen as a logical starting point. Results derived from such a study would be strictly applicable to welding and cutting in towers. However, the basic findings should be extendible to other types of work in enclosed spaces, such as spraying, cleaning and abrasive blasting. In scope, the research was divided into several phases—literature survey, evaluation of existing ventilation techniques, determination of optimum ventilation schemes, and development of ventilation criteria.

Summary of Available Data

The purpose of this phase of the study was to determine what had been done regarding control techniques and criteria for work in enclosed spaces. Information regarding gases and fumes, composition and quantity, during welding and cutting were also relevant in relation to ventilation criteria.

Tebbens and Drinker[1] reported information pertaining to various type electrodes. The major components of mild steel welding fumes were Fe_2O_3, TiO_2 and MnO_2. Stainless steel fumes contained relatively high quantities of fluorides derived from the electrode coating in addition to the oxides of chromium, nickel, calcium and silicon. J. W. Roe[2] discusses gases and fumes from fusion welding and his data are in broad agreement with those



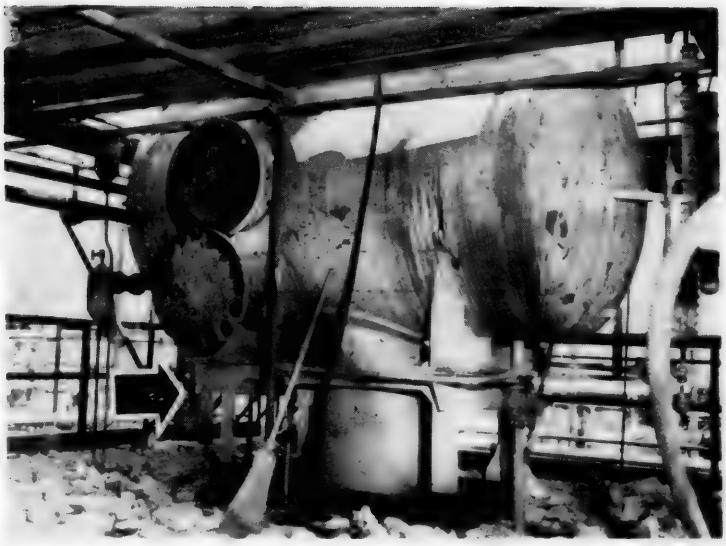


Fig. 1 (left). Tray removal and replacement were done in the top half of this 150-ft tower; both torch cutting and welding were studied at different levels. Fig. 2 (above). A high degree of confinement was encountered during welding of a nozzle in this 190 cu ft reflux drum.

previously cited. Nitrogen oxides and ozone are the major gases of toxicological importance evolved and both investigators mentioned that the hazard is very low for manual arc-coated rod welding. Little information is available, however, concerning cutting. Tebbens and Drinker conclude that ventilation specifications can be written with the concentration of visible particulate matter as a criterion. Where welding is done in an almost totally enclosed space of 2000 cu. ft. or less, they suggest the following minimum ventilation rates per welder for general air dilution to 30 mg per cu. meter:

Steel electrodes	CFM
5/32 in.	250
3/16 in.	400
1/4 in.	700
Alloy (fluoride coated), 5/32 in.	250
Galvanized plate, 5/32 in.	1000-1500

The American Standards Association[3] and the U. S. Department of Labor[4] define a confined space as one having less than 10,000 cu. ft. per welder or having an overhead height of less than 16 feet. Any work space may also be considered confined if structural barriers obstruct cross ventilation. Recommended ventilation for such spaces is 2,000 cfm per welder, minimum. The Bureau of Ships[5] specifies forced ventilation air requirements in enclosed spaces (5,000 cu. ft. or less) when welding on uncoated ferrous metals as follows:

Space volume, cu. ft.	Minutes per air change
4000-5000	4
3000-4000	3
2000-3000	2
Less than 2000	1

This Navy manual also summarizes the many variables which must be evaluated in addition to the above requirements.

1. Dimensions and geometry of work space
2. Number of operators (gas or electric)
3. Composition of coatings of metals
4. Type and size of electrode and amperage used
5. Rate of welding
6. Effects of air currents in work space; are fumes concentrated in breathing zone
7. Tendency of fumes to stratify or flocculate
8. Effects of visibility on accident rate
9. Excessive heat

Use of local exhaust ventilation is well documented in the references cited suggesting flow rates of 100 fpm at the point of welding for control. Local exhaust or respiratory protection are mandatory when fumes of cadmium, mercury, lead, or other highly toxic fumes are evolved. This type of con-

trol has certain drawbacks most important of which is that close cooperation of the workmen is required in placing and moving the hoods for good control. Also, hoses are cumbersome in small areas, especially in that they may hinder the movement in and out of small openings.

As mentioned, little or no data are available concerning hazards and control of cutting operations. Only brief mention is made of the magnitude and control of excessive heat in practical situations. Based on energy input, the order of magnitude of heat release per electrode is 400-500 Btu, a significant quantity, especially during warm weather work.

Results of this literature survey appear to be in line with unpublished industrial hygiene survey data and support the conclusion that improved means for ventilating confined spaces is desirable. For vessel ventilation of this type, general ventilation has merit over local exhaust. While the data reported may serve as base lines, insufficient information is available to permit practical application of equipment and techniques for control of day-to-day work in enclosed spaces.

Existing Techniques

The basis for appraisal of ventilation effectiveness was the extent of fume and heat reduction attained through the use of various equipment and methods commonly employed. Studies made during turnaround operations (periodic scheduled or unscheduled maintenance) in a variety of refinery vessels formed the basis for these field studies, namely 20 cases. Welding and/or cutting was done in:

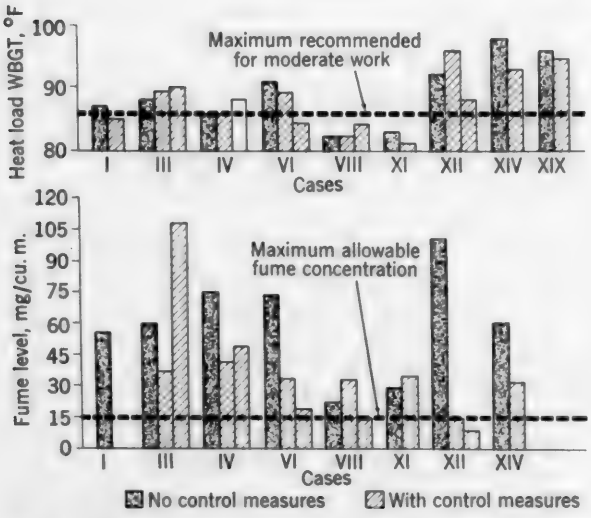


Fig. 3. Comparative results for fume and heat as obtained in a variety of actual situations. Even when control measures were employed, excessive levels can be seen to exist. Results formed the basis for a detailed study of confined-space ventilation.

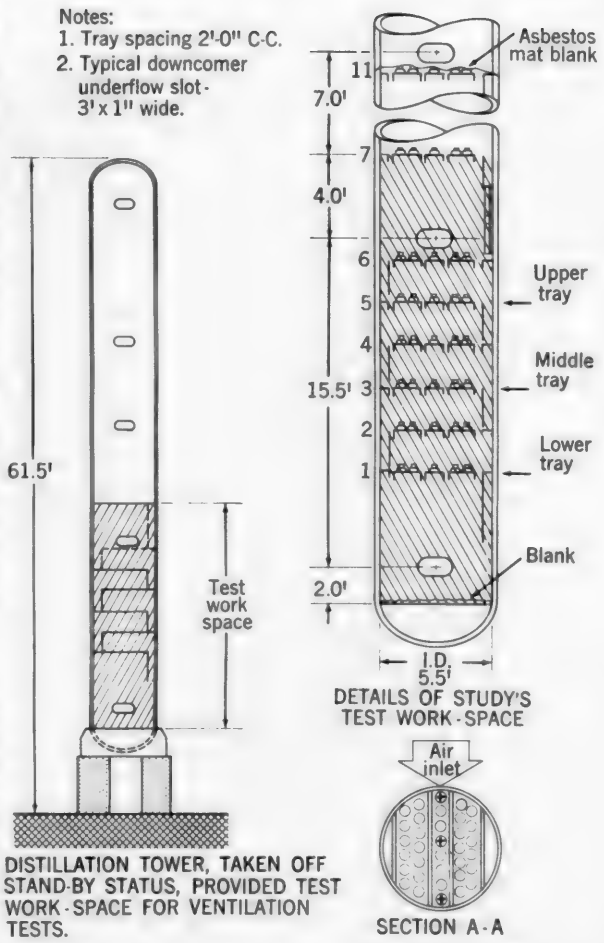


Fig. 4. Baton Rouge refinery test work space. Work was done on trays 5, 3 and 1, and progressed down the tower from the manhole near tray 6. On each tray data were taken at the three cross-marked locations in section A-A.

1. A 10-ft. diameter isobutane tower (Fig. 1)
2. A 7-ft. diameter butane tower
3. A 10-ft. diameter circular drum (front cover)
4. A 7-ft. diameter re-run tower
5. A 5-ft. diameter cylindrical drum (Fig. 2)
6. A 20-ft. by 10-ft. acid sludge settler
7. Railroad tank cars

It had been hoped that direct comparison of fume and heat levels—measured with and without ventilation—could be made to show whether or not the ventilation was doing an effective job. While this practice was followed in much of the field work, the urgent nature of turnaround completion made it impossible to obtain "matched" sets of data in all cases.

Fig. 3 shows the results obtained where comparative measurements could be made. As can be seen from this chart excessive conditions often occur

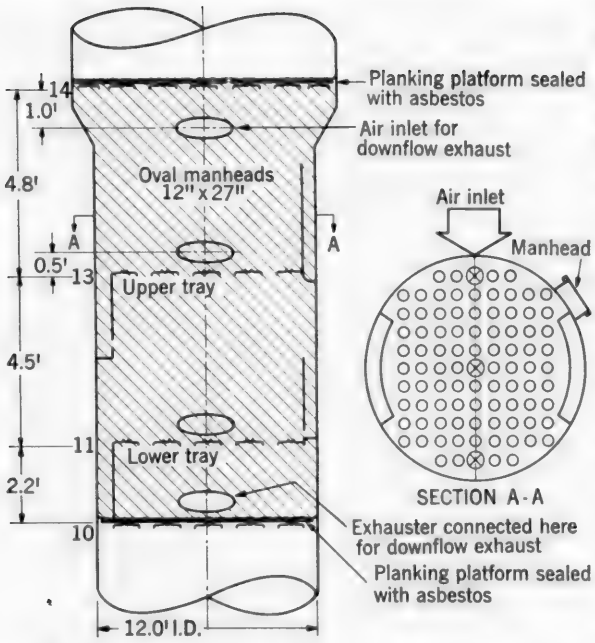


Fig. 5. Bayway refinery test work space. Work was performed on and between trays 13 and 11. For each situation data were obtained at the cross-marked points in section A-A.

when present ventilation measures are used. Fume and heat were cut an average of one-third where ventilation was used; but actual ventilating practice sometimes increased fume levels. Often, levels of fume and heat were well in excess of maximum recommended limits. It was found from these studies that on turnaround jobs, the decision of whether or not to ventilate is usually left to the individual. Even though equipment is provided, in only about 50% of the jobs is it used. Frequently the ventilation method utilized is not the best.

In the review of existing methods and techniques it was soon recognized that the basic concepts of air flow in relation to contaminant removal were not being considered. Assuming a work place between two manheads, air can be directed up or down, and these conditions can be achieved by either blowing or exhausting. It is also possible to blow and exhaust simultaneously in opposite manheads creating a push-pull ventilation scheme; this is often done. Welding position, up or downhand, was another variable noted.

Optimum Ventilation Schemes

The basic data having been reviewed, a research project was designed to evaluate the most effective ventilation method for reducing fume and heat levels.

This phase of the program consisted of evaluating the optimum ventilation in a 5.5-ft. diameter vessel. After making this determination, extension of the data to a 12-ft. diameter vessel would be attempted to assess the effect of diameter or work space area on the ventilation scheme(s) selected. In conjunction, ventilation criteria which could be practically employed were to be developed. The work was done in two refineries of Humble Oil and Refining Company—the Baton Rouge, La., refinery in the summer of 1959, and the Bayway, N. J., refinery in the winter of 1961. These towers are detailed in Fig. 4 and 5.

Fume Generation. Since this variable was to be standardized, an effort was made to utilize similar welding rate, cutting rate, amperage, voltage and the like during test runs by study personnel. The fume was restricted to four different processes and materials: welding on mild and stainless steels, gas cutting of mild steel, and arc-cutting of stainless steel.

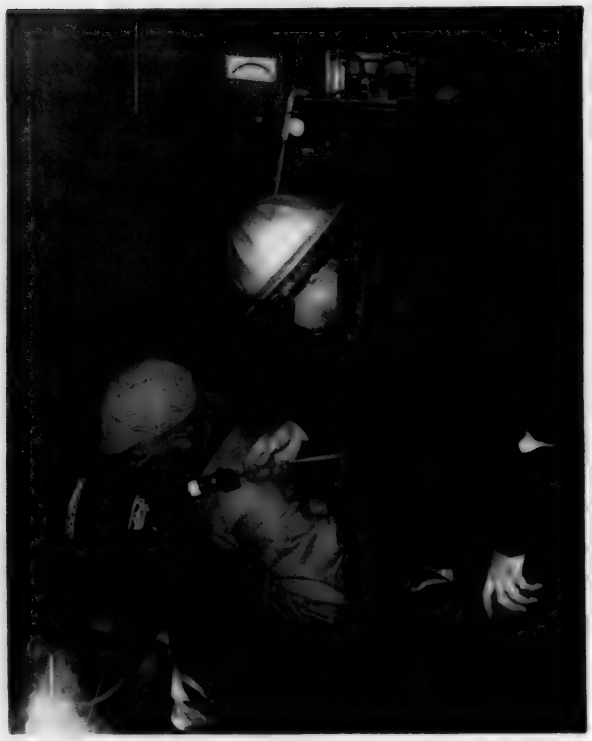
Welding of mild steel plate was performed at a constant rate of about 3 to 4 coated rods (5/32-inch dia. x 14 inches long) each 5 minutes. During the studies constant output of the welding machine was maintained.

The energy consumed in torch cutting was maintained at a normal and fairly constant rate during the testing. A No. 6 cutting tip was used to cut successive strips of 4-inch dia steel pipe, (⅜-inch wall thickness). Actual gas rates during the cutting were 8.5 SCFH (standard cubic feet per hour) propane and 150 SCFH compressed air.

Type 304 stainless steel pipe (4-inch dia—⅜-inch wall) was cut into successive strips by the arc-cutting process. This technique utilized ¼-inch copperclad carbon-graphite electrodes operated at up to 400 amps and 30 volts with a constant setting on the welding machine.

Sampling and Instrumentation. Reduction of fume in the work space at the worker's breathing zone was the criterion used to compare the effectiveness of the ventilation rate and the technique used. As a base-line condition fume levels were measured without ventilation. The effectiveness of the schemes used was then compared with the no ventilation level. Figures 6 and 7 show a typical before-and-after situation encountered. The welding or cutting operation was conducted at three points on a tray —at the tray center, and nearest to, and farthest from the air inlet. Breathing zone samples of fume concentrations were obtained at each position. The sampler head was held in such a way to collect air as it would be inspired by the welder. This work was repeated on different tray levels in the two towers studied under controlled conditions.

The time required for the work space to reach steady state conditions was evaluated by both a heat balance on and fume loading in the work space. This period is best described as a build up from "no work" conditions to steady state. After build up, a dynamic



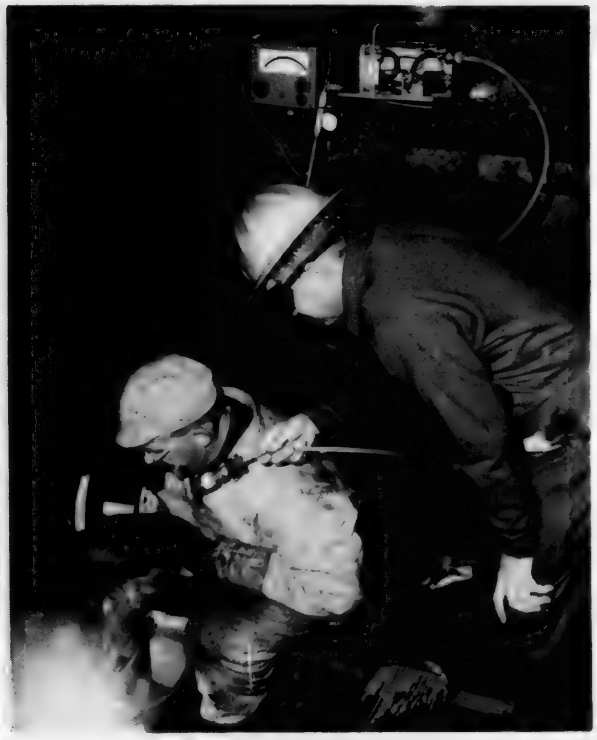


Fig. 6 (left). Welding without ventilation is shown being studied. A sample of fumes taken in the welder's breathing zone was measured at 80 mg per cu. m. Fig. 7 (right) shows same situation but with a downflow general exhaust of 53 fpm average velocity being employed. The fume concentration was reduced to 5 mg per cu. m.

equilibrium is established between the generation of heat and fume by the work and their removal from the work space by ventilation. It was found that the concentration of fume tended to maximize because of rapid flocculation, particularly at high concentrations. The steady state period represented conditions of maximum fume concentration developed during the test. After the build up period, the air in the welder's breathing zone was sampled for 5 to 10 minutes. Also during this period measurements were made in the Baton Rouge tower to determine the heat load to which the worker was being exposed, at steady-state. In this vessel, because heat was a parameter, a 10 minute "clean out period" followed the sampling to bring heat back to "no work" levels prior to the next cycle. In the Bayway study—done in the winter—this was not necessary and the next cycle was conducted without a "clean out" step. The two approaches were evaluated and found to be identical as far as generated *fume* levels were concerned.

The environmental factors affecting heat stress were measured by means of dry bulb, wet bulb, natural wet bulb, and black globe temperatures and air velocity. Work was estimated to be moderate or at a metabolic expenditure of about 700 Btu per hr.

Control Measures. It was found that the Lamb air ejector was the most commonly employed air mover in the refineries studied. In the initial study of existing practice it was found that often these units were not used correctly. Unless the opening through which the Lamb units exhaust air is fully covered, much of the air handled will "short circuit." That is, air around the outside of the opening —instead of air from the work space—will be drawn into the ventilator. Fig. 8 shows such an ineffective installation while Fig. 9 shows how this was corrected with a gusset plate. The gusseted Lamb units are hung on the manway lip by angle straps which give a good air seal. These units were used during the study to provide general exhaust ventilation. The vaneaxial fan shown in Fig. 9 was outfitted with a sheet metal adapter to fit the oval manheads in the Bayway study. Other control measures employed were the use of a local exhauster and air circulation provided by a household-type fan in conjunction with low rates of general ventilation.

Results and Observations

Fume Control. Fig. 10 summarizes the average performance obtained in the Baton Rouge study for various ventilating schemes applied to downhand

welding. The results are for a ventilation rate of 1600 cfm or 67.5 fpm average velocity. For a higher flow rate of 2500 cfm the average fume reduction was about 8% better while at a rate of 1000 cfm the results were poorer by a similar amount. These flow rates were chosen because they were within the capacity of the Lamb air movers used.

Although all methods showed a large reduction in fume levels—even the poorest having an 80% reduction—schemes V-3 and V-4, where the air was mechanically exhausted out the bottom below the work space, were the best. The values in Fig. 10 represent average fume levels within the tower. As would be expected these levels varied on different trays within the tower and at different positions on the tray. One or more of these locations might show poorer performance than the average. However, it was felt that for evaluation purposes, the average fume concentration was most descriptive.

From the above information, exhausting only, out of the lower opening, can be considered best for downhand welding. There are five other advantages to this scheme:

(1) With the top manway open easy entrance and exit is provided.

(2) Hoses, cables and materials may be easily pulled into the work space.

(3) Communication with the outside man is facilitated.

(4) Ventilators used to supply air to the work space may create noise levels of such magnitude as to represent a potential source of noise-induced hearing loss, (e.g., when used to supply air, the 10-inch Lamb ventilator—operated with 22 psig air at the unit—gave an overall sound pressure level of 108 db in the Baton Rouge tower. From octave band analysis information, it was found that exposure to this noise for more than three hours per week might involve the risk of long-range hearing loss[6]).

(5) Ejectors used as supply ventilators may supply air of poor quality, since compressed air used to drive the unit might contain rust particles, oil droplets and carbon monoxide.

Overhead welding was similarly studied with various ventilation schemes. Fig. 11 gives a summary of these results which show that upflow ventilation —exhausting only—is preferred. Obviously it would be undesirable and perhaps impractical to alternately change the direction of air flow to accommodate the type of welding performed; that is, relocating the air exhauster as the welding operation changes from uphand to downhand and vice versa would not be acceptable.

Since upflow exhaust is the most effective way of controlling fume from overhand welding and downflow exhaust is the most effective way of reducing fume from downhand welding, the ventilation scheme selected should depend upon the predominance of the welding operation conducted. When there is no clear case, downflow exhaust, for the practical reasons suggested previously, would be preferred.

Fume Levels and Standard Ventilation Tests. The fume loading data for downhand mild steel welding were averaged for each velocity studied in both the Baton Rouge and Bayway towers. The concentration of fume in the breathing zone of the welder at the near edge, center and far edge was averaged for the trays studied at each downflow velocity employed. The Baton Rouge work space was much deeper (see Fig. 4 and 5), hence three tray levels were studied there compared to two trays in the Bayway test.

Analysis of fume concentration versus average tower velocity yielded a regression equation (with probability exceeding 99.9%) as follows:

$$\log C = 1.85894 - 0.02154 \frac{Q}{A}$$

where C = concentration of mild steel welding fume, mg per cu. meter,
Q = total air volume exhaust rate, cfm,
A = cross-sectional area of the tower, sq. ft.

It is obvious from the correlation obtained that tower diameter—in the 5.5 to 12-ft. range—does not affect the manner in which fume is controlled by general exhaust ventilation.

The regression curve developed for mild steel welding shows that the decrease in fume content follows a logarithmic decay pattern. The regression coefficient, —0.02154, gives the decay rate which would be expected for any fume controlled by general exhaust ventilation in the confined spaces studied. This extension of the data to other fumes (or their components) is logical and to be expected based on the character of fumes and the mechanism of air dilution control.

By re-arranging the regression equation into a generalized expression it becomes more useful. Thus:

$$Q/A = 46.43 \log (C_i/C)$$

where C_i = initial concentration (without ventilation), mg/cu.m.
C = desired concentration (with ventilation), mg/cu.m.
Q/A = average tower velocity, fpm

The solution to the generalized expression and conversion to suggested ventilation rate has been developed in an alignment chart, Fig. 12. Estimates of fume or component concentration without ventilation have been summarized from both the Baton Rouge and Bayway studies and are tabulated in Table 1 in Fig. 12. These values should be considered as estimates only. They may be revised or amended as more data are accumulated from various operations in enclosed spaces.

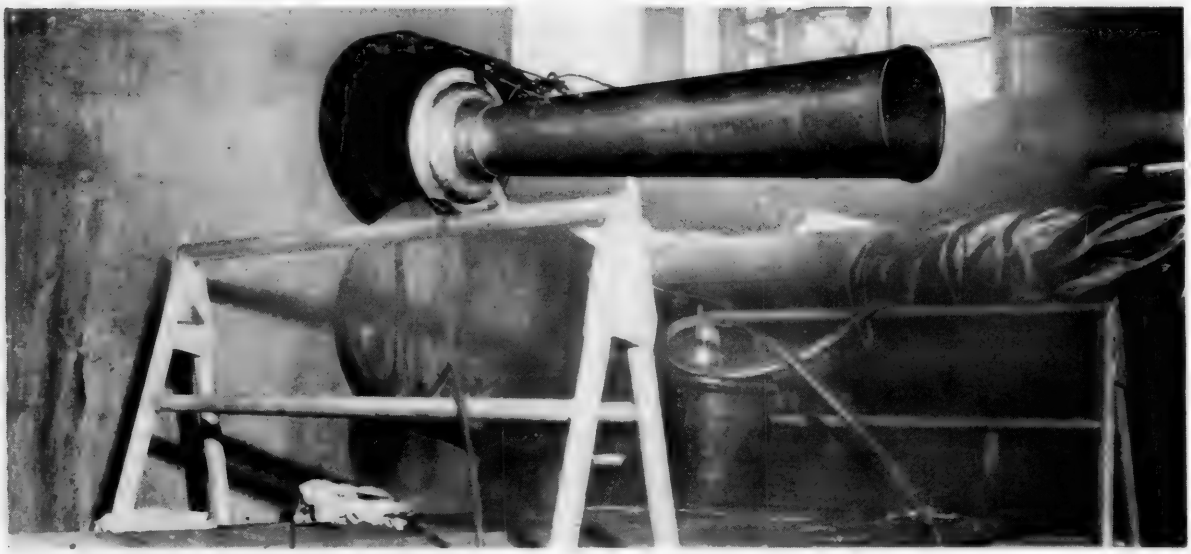


Fig. 8 (above). As installed on the oval manhead, this air ejector is handling more outside air than work-space air. Fig. 9 (left). Installing a plywood adapter to prevent short-circuiting of air improves the ejector's efficiency in exhausting the work space. Two air lines feeding ejector also improve its performance. Vane-axial blower on deck was used in study to obtain high flow rates.

Use of Chart. In using the alignment chart (Fig. 12) the total fume or component of the fume *without ventilation* is estimated or taken from Table 1. Values here represent fume concentration and analysis data obtained during the course of the ventilation study. The concentration value on the right scale is connected to the diluted concentration desired on the scale immediately to the left. The line thus established is continued to intersect the center scale (velocity and fume reduction scales) which serves as a pivot line. The tower diameter on the slanted scale is now connected with the intersection on the pivot line and the line continued to intersect the left scale, the suggested ventilation rate. It should be noted here that at the center scale the average tower velocity and/or the percent fume reduction obtained may be read. However, neither item is necessary to estimate the exhaust ventilation rate. The following examples show how this method is used to solve actual problems.

Example 1: Stainless steel welding using 5/32-inch electrodes will be performed in a 10-ft. dia vessel. How much exhaust ventilation would be needed to maintain chromium content in the fume to 0.1 mg per cu.m.?

Solution: The solution is shown on the alignment chart. From Table 1, assume the average CrO_3 concentration without ventilation is 0.93 mg per cu.m. Connect 0.93 mg per cu.m. on the right scale (component without ventilation) to 0.1 mg per cu.m. on the next scale to the left (component with ventilation). Extend this line to intercept the center scale.

Join this point with 10 feet on the tower diameter scale (slanted) and read 3530 cfm on the far left scale as the suggested ventilation rate. This flow will take care of average conditions. If further assurance of control is needed, higher air flow rates can, of course, be used. The alignment chart can again be employed in the same manner, but instead of starting with 0.93 mg per cu.m., use perhaps 1.6 mg per cu.m. of CrO_3. The suggested flow obtained by this recalculation is 4390 cfm.

Example 2: Mild steel welding will be done with 5/32-inch electrodes in a 7-ft. dia tank. What rate of exhaust ventilation would be needed to control fumes to 15 mg/cu.m.?

Solution: For the welding conditions specified, an average fume concentration of 72.3 mg per cu.m. is expected as noted in Table 1. Connect 72.3 mg per cu.m. on the right scale (fume without ventilation) to 15 mg per cu.m. on the next scale to the left (fume with ventilation) and continue the connecting line to intercept the center scale (average tower velocity). Now join this intersection point with 7 ft. on the tower diameter scale (slanted) and read 1230 cfm as the suggested exhaust ventilation rate on the far left scale.

An extension of the fume emission data from the 5/32-inch x 14-inch electrodes to other size electrodes has been studied by Tebbens and Drinker. The characteristics of different size coated rods evaluated in their study are tabulated in Table 2 along with a ratio of fumes released related to 5/32-inch electrodes.

They concluded that ⅓ to ½ of the fume from steel electrodes can be attributed to the coating. However, it was noted that even with almost identical electrodes, relative to core and coating weight, the fumes generated could vary as much as three-fold. The wide variation was explained by differences in coating materials. The fume ratios, viz., 1:1.8:3.9, can be applied to the fume concentration data shown in Table 1 for use with the alignment chart. In this manner estimates can be made of initial fume

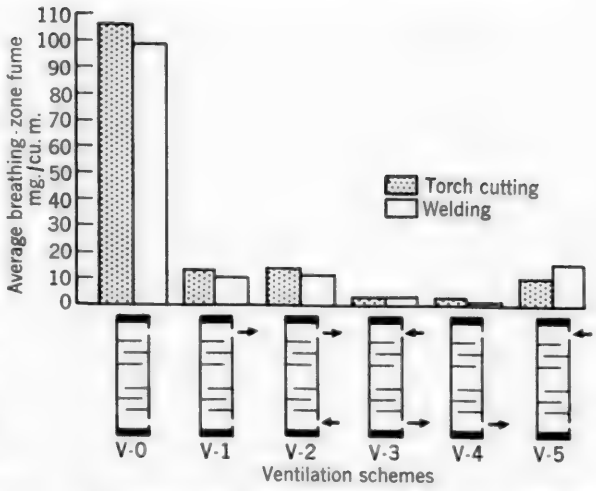
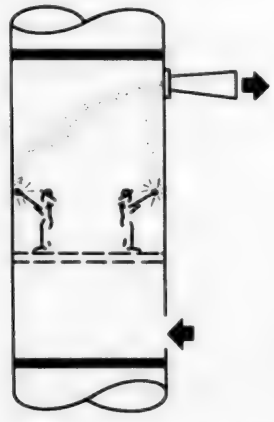


Fig. 10. Comparative performance of the five ventilation schemes studied for downhand welding and cutting. Although all schemes gave good results compared to no ventilation (V-O), schemes V-3 and V-4 showed that downflow exhaust was the preferred method.

concentration when using other than 5/32 in. electrodes. For example, if in Example 1 the electrodes had been ¼ x 14 inches instead of 5/32 inch, the average concentration, last column in Table 1, would be $0.93 \times 1.8 = 1.67$ mg per cu. m.

One other aspect should be considered—that of more than one welder in the work space. The study considered only one welder working at a time. Clearly, many welders working simultaneously will produce more fume than one welder. Therefore, the fume estimates shown in Table 1 should be multiplied by the number of welders working together to get a better assessment of fume released in the work space.

However, there is a limitation to using both of these multiplication factors. That is, there appears to exist an upper level of fume concentration that can be sustained before flocculation and agglomeration occur. The resultant large particles settle out of the air quite rapidly; particularly at high con-



WORK	AVERAGE VELOCITY, fpm	FUME IN BREATHING ZONE, mg/cu.m.	
		UPFLOW SCHEME	DOWNFLOW SCHEME
OVERHEAD WELDING	0	50.7	50.7
	22	7.8	17.6
	37	4.4	10.2

Fig. 11. Results obtained in a study of overhead welding showed that upflow exhaust ventilation is preferred for overhead work.

Fig. 12. Alignment Chart for Fume Control Ventilation

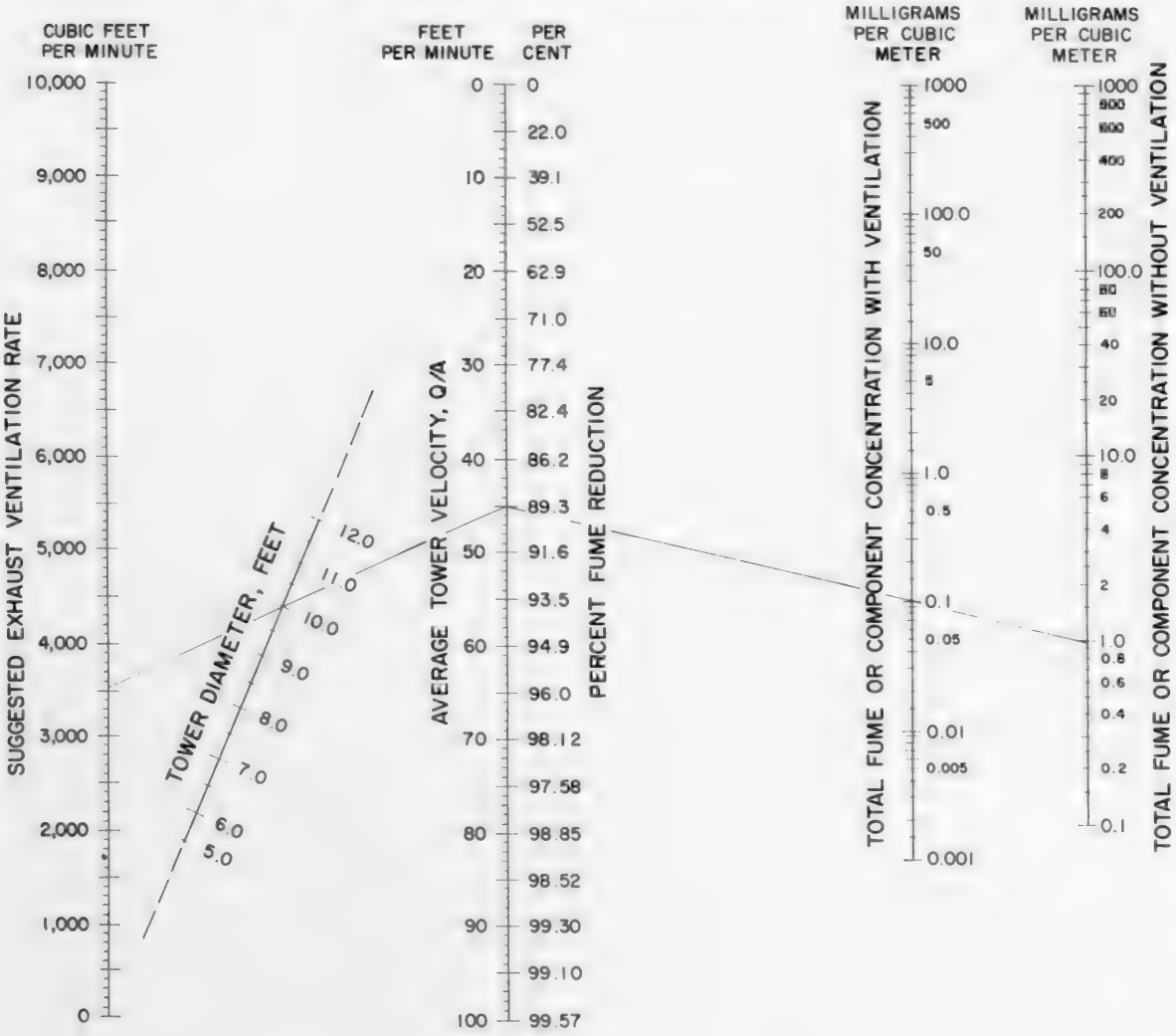


Table 1

FACTORS FOR USE IN DETERMINING CONFINED SPACE VENTILATION

OPERATION	MATERIAL	LIMITING COMPONENT IN FUME	TARGET CONCENTRATION WITH VENTILATION mg/cu.m.	ESTIMATED CONCENTRATION WITHOUT VENTILATION, mg/cu.m.	
				RANGE	AVERAGE
WELDING	MILD STEEL	TOTAL WEIGHT	15	33-206	72.3
TORCH-CUTTING	MILD STEEL	TOTAL WEIGHT	15	38-224	105.
WELDING	STAINLESS STEEL	CrO_3	0.1	0.6-1.6	0.93
ARC-CUTTING	STAINLESS STEEL	CrO_3	0.1	9.4-16.0	12.5

This alignment chart for determining ventilation requirements in close-quarter work spaces is a generalization of the regression equation developed in the text. Table I serves as a guide in estimating fume concentration without ventilation for various operations. The authors feel that the chart is applicable to any close-quarter work involving contaminants.

Table 2. Relationship of Fume to Electrode Size

Electrode size, inches	5/32 x 14	¼ x 14	5/16 x 18
Weight core metal, gms	34	89	178
Weight coating, gms	10	24	51
Power, watts	4500	9900	18,000
Fumes per electrode, gms	1.3	2.3	5.0
Fume ratio related to 5/32-in electrodes	1.0	1.8	3.9

centrations the decrease in fume content may be as much as 50% in one-half hour.[1] Thus, even though the factors described above may predict rather high initial fume concentrations, the actual level may be significantly lower. *Tests in the vessels studied gave maximum levels of about 250 mg per cu.m.* Values much beyond this would not be expected to occur.

Between-Tray Work. It was found during the course of these studies that air entering a work space is most effective when it can be directed from the inlet to the man and then out through the exhauster. If the air must first pass through some restriction such as a bubble tray, its effectiveness is diminished and its fume controlling properties are accordingly reduced. Such a situation occurs when a man must weld between trays where no manway exists for entering the space from the outside. This requires the welder to cut a small opening in either the top or bottom tray and work his way into the space to perform the tasks required. Obviously work under such conditions poses additional ventilation problems because the presence of trays both above and below tends to restrict motion. This situation was simulated in the Bayway tower. The results, averaged across the tray, are shown in Fig. 13. It can be seen that as the average velocity was increased, the levels of fume from both mild steel and stainless steel welding were reduced. Although the levels were lowered by similar percentages, they were not reduced by the same order of magnitude as would have occurred at the same air flow if the tray above the worker were not there.

Use of Air Circulation. The Baton Rouge study explored the directional aspects of air movement in confined spaces. It became evident that the key to best control lies in moving the contaminant away from the breathing zone. The direction of the generated heat, fume or other contaminants in relation to the breathing zone must be counteracted by direction and velocity of cleaner air. Apparently this concept is so basic it is often overlooked in setting up ventilation for confined space work. As shown in Fig 14, by simply sketching in trained arrows, a good picture of the effective airflow direction can be obtained. The situation on the left is not uncommon; air is blown into both openings creating turbulence and poor removal of fume. A little thought, and perhaps a sketch, would have given good air direction and control away from the breathing zone as shown on the right. *It can be concluded from this figure that ventilation rate in itself may be less important a factor than the ventilation scheme used for controlling the confined space contaminants.* A scheme which gives undesirable air patterns in a work space may give equally poor control at high or low flow rates.

Fig. 15 presents the results obtained from an experiment to ascertain the effect of circulating the welding fume throughout the work space in an effort to dilute the breathing zone concentration. An average tower velocity through the confined space of only 22 fpm was employed for this test. A household-type propeller fan with a rheostat to control fan revolution rate was used to direct work space air between the worker's breathing zone and the welding task. It can be seen that a velocity of 100 fpm through the working zone gave excellent control of the fume level. Control was improved slightly by increasing the circulation rate to 300 fpm, but because the fume level was already quite low at the 100 fpm condition, only minor improvement would be expected.

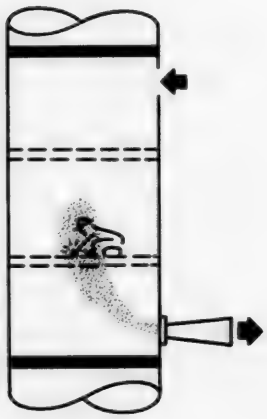
The volume delivered by the household-type fan was estimated to be 130 cfm at the low rate of 100 fpm in the welding zone and 420 cfm at the 300 fpm rate.

At 300 fpm sparks actually turned in their flight and were redirected away from the fan. Fume clearly moved away from the worker. As the velocity of the fan was decreased the sparks hit the fan blades although fume was still being controlled. At about 30 to 50 fpm the fume was not controlled but drifted into the breathing zone. The test was interesting because it showed that there are two factors in controlling fume within confined spaces:

1. The effect of air change rate through the work space;
2. The effect of distributing contaminants from a local generation point throughout the work space to obtain maximum dilution.

Table 3. ASA Local Exhaust Specifications

Distance from arc or torch, inches	Minimum air flow, cfm	Duct diameter, inches
4-6	150	3
6-8	275	3½
8-10	425	4½
10-12	600	5½



WORK	AVERAGE VELOCITY, fpm	FUME IN BREATHING ZONE mg/cu.m.	
		MILD STEEL	STAINLESS STEEL
DOWNHAND WELDING	0	75.9	52.8
	22	34.7	20.0
	37	26.8	15.8

Fig. 13. When a restriction such as another tray is situated in the path of incoming air, the fume controlling properties are diminished. The results shown here substantiate this conclusion.

A combination of the two, as shown in this test, seems to be the most satisfactory way of controlling fume when general ventilation alone will not suffice. Use of a circulating fan plus low general ventilation would have advantage in winter work. During the cold weather, workers might be reluctant to use high ventilation rates because of the chilling effect. However, lower rates with the circulating fan might have greater appeal.

This combined approach would also have application in the control of fume generated during between-tray work described previously.

Local Exhaust. If properly applied, local exhaust can be quite useful in all types of welding situations including confined space work. The American Standard[3] on this subject contends that freely moving exhaust hoods should be provided with a rate of air flow sufficient to maintain a velocity of 100 feet per minute in the zone of welding. Shown in Table 3 below are ASA recommendations for rates of ventilation required to obtain this control velocity using a 3 in. wide flange on the exhaust hood. If a flange is not employed the minimum air flow should be increased by 20%.

Tests in the Bayway tower with a 4 in. unflanged round duct found that as little as 80 cfm applied at 8 inches from the welding zone captured about 85% of the fume generated (see Fig. 16).

Although local exhaust provides removal of fumes with comparatively low flows, the area of influence of the exhaust opening is limited. At about one diameter from the plane of the exhaust opening, the air velocity has decreased about 90%. Therefore, to obtain maximum effectiveness the welder must re-position the exhaust hood as he changes welding locations to keep the hood in close proximity to the fume source.

Thus, active cooperation by the welder is inherent in this type of control procedure. Another drawback to this method in enclosed spaces is the fact that the exhaust duct must pass through the manway so that the collected fumes and gases can be discharged to the outdoors. This obstruction of the exit, particularly in the case of an emergency, may be objectionable. Also, if heat is a problem, the small air movement obtained with a local exhauster would not be adequate for heat control.

Tandem Positioning of Workers. Sometimes work is conducted at several levels in a tower, as shown in Fig. 17. If the workers are separated by blanks (made by fitting wooden platforms and asbestos on an intermediate tray), then each section can be treated as a single work space to be individually ventilated. On the other hand, this isolation may

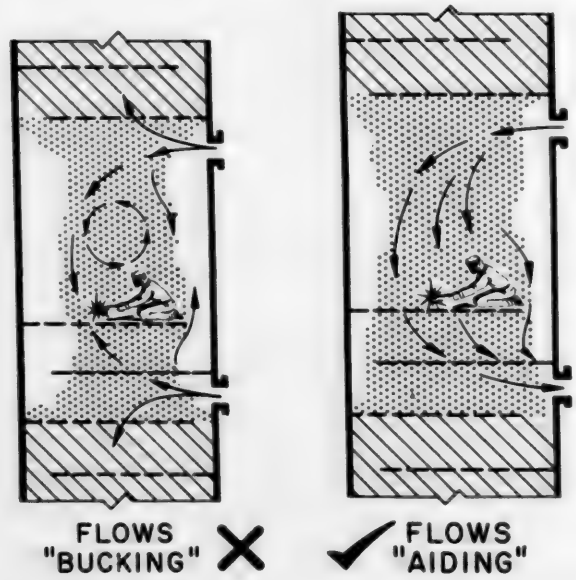
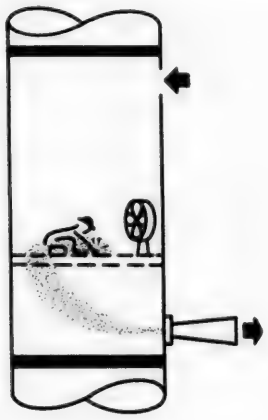
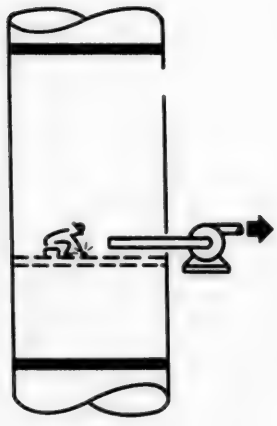


Fig. 14. A ventilation technique, regardless of its flow rate, must give desirable air flow patterns in the work space to be effective.



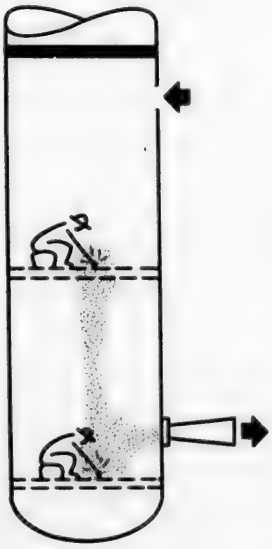
WORK	AVERAGE VELOCITY, fpm	FUME IN BREATHING ZONE, mg/cu.m.
DOWNHAND WELDING - MILD STEEL	22	17.0
	22 + 100 fpm CIRCULATION	3.6
	22 + 300 fpm CIRCULATION	2.6

Fig. 15. Low rate of exhaust ventilation can be employed if the fumes generated are displaced from the welder's breathing zone by a directional velocity of 100 fpm. A small fan or similar device can be used to provide the dispersion required.



WORK	AVERAGE VELOCITY, fpm	FUME IN BREATHING ZONE, mg/cu.m.
DOWNHAND WELDING - MILD STEEL	0	65.3
	0 + 80 cfm LOCAL EXHAUST	9.5

Fig. 16. The local exhaust unit used in these tests was placed 8 inches from the welding and collected about 85% of the fume. Importance of placing unit as near as possible to the work cannot be over-emphasized.



WORK	AVERAGE VELOCITY, fpm	FUME FROM UPSTREAM MAN ENTERING THE DOWNSTREAM BREATHING ZONE, mg/cu.m.
DOWNHAND WELDING - MILD STEEL	42	18.3
	105	5.7

Fig. 17. Tandem work poses a difficult ventilation problem as these data clearly indicate. Breathing air of the downstream man may contain contaminants generated by upstream operations.

TABLE 4. DATA ON HEAT PRODUCTION FROM WELDING AND CUTTING

Operation	Temperature, Deg F		Heat Values			
	Outside	Work Place	Radiation, Btu per hr	Convection, Btu per hr	Ventilation, fpm	Yaglou index WBGT
Welding	84	87	0	(150)	67	82.5
Cutting	83	97	375	45	67	88
Welding	88	90	115	(140)	104	82
Cutting	88	94	480	(25)	104	88
Welding	89	100	310	53	0	90
Cutting	89	123	700	340	0	100

Note: ( ) = cooling

not be practical or feasible in some installations. It is then that pollution of breathing air between working levels adds an extra burden to the downstream man.

The downstream man is in a poor position because, first, as was discussed in between-tray work, restrictions which reduce the random motion of air tend to lower the fume controlling properties of the ventilation scheme employed and, second, the fume and heat generated by the upstream welder(s) will contaminate, to some degree, the breathing air of the downstream man.

Tests in the Baton Rouge tower showed that with a welder three trays above, the "fresh air" supplied to the downstream man may contain as much as 18 mg per cu.m. of welding fume. This must be added to the expected fume levels from his own welding or cutting task.

Therefore, tandem positioning of burner-welders at opposite ends of a work space makes the job of ventilation more difficult. A possible solution to such a set-up would be the use of local exhausters, particularly important at the upstream position to capture the fumes before they can enter the downstream breathing air. Another approach would be to use high rates of general ventilation along with a circulating fan (see section on Use of Air Circulation) for the downstream man.

Nitrogen Dioxide. Numerous samples of work space air were analyzed for nitrogen dioxide by the Mine Safety Appliance Co. detector kit. Samples were taken during welding and arc cutting, with and without ventilation. Maximum *fume* concentrations for these operations were 120 and 250 mg per cu.m., respectively. In all cases NO_2 values were below the limit of detection, less than 5 ppm. These data are in agreement with those of Tebbens and Drinker who concluded that the NO_2 produced from coated electrode arc welding, will not exceed the maximum allowable concentration of 5 ppm unless the fume concentration exceeds at least 90 mg per cu.m. and most often 500 mg per cu.m. Arc cutting with copperclad carbon electrodes also appears to require an extremely high fume concentration before NO_2 can be detected.

Effects of High Temperatures. In addition to fumes and gases from welding and cutting operations, heat is a significant problem and often affects both quality and quantity of work output.

Heat data were taken during summer conditions while welding and cutting in the 5½-ft dia tower at Baton Rouge. These data, presented in Table 4 show maximum heat conditions within the tower on the intermediate tray after a standard work period of 15 to 20 minutes.

Radiation and convection were calculated using the method proposed by Haines and Hatch[8] and reflect biophysical heat stress on the worker. The Yaglou Index[9] (WBGT) is an expression of heat level imposed on the body and is calculated from the formula:

$$WBGT = 0.7\ NWBT + 0.3\ BGT$$

where NWBT = Natural wet bulb temperature, deg F (from a stationary wetted thermometer bulb),

BGT = Black globe temperature, deg F

An index of 86 is tentatively suggested as the maximum for a continuous work schedule of 50 minutes on and 10 minutes off. A level of 100 represents very severe physiological strain.

Note in Table 4 that gas torch cutting results in a greater heat load on the worker than does welding under the conditions studied. The heat of combus-

tion of the cutting torch, utilizing 9 cubic feet per hour of propane, was calculated to be about 22,000 Btu per hr. Based on wattage supplied to the 5/32 in. welding electrodes, the heat input is calculated to be about 15,000 Btu per hr. Subjective feelings of warmth also suggest that gas cutting produces a warmer environment.

Under conditions of no mechanical ventilation and at outside conditions as in Table 4, excessive heat from both welding and cutting can occur and may lead to severe physiological strain. With forced ventilation, even at the lowest flow rate of 42 fpm used in the study, all heat levels during welding were below an index of 86 and assumed to be of no health significance. Cutting operations consistently produced heat indices higher than desirable for extended exposures during warm weather work.

Convective cooling is the most practical method for heat control in these situations. Increased velocity and/or supply air cooling may be required. The convective cooling effect on man can be estimated from the equation[8]:

$$C = 2.1 \sqrt{V} (t_a - 95)$$

where C = Btu per hr
V = air velocity, fpm
t_a = air temperature, deg F
95 = assumed skin temperature, deg F

As work place air temperature approaches skin temperature of 95 deg, cooling effect is decreased; if air temperature exceeds 95 deg, air velocity will add convective heat to the man. As discussed in a previous section, ventilating air required for fume removal can be estimated by means of the alignment chart, Fig. 12. When welding fume is controlled to less than 15 mg per cu.m. (the 8-hr maximum allowable concentration), heat will generally be controlled as well. This assumes of course that ambient conditions are similar to those of the test conditions with a maximum of 90 deg dry bulb temperature. For other conditions and especially for cutting, excess air over and above that required for fume removal may be necessary for satisfactory heat control. Where sufficient cooling cannot be attained under practical limitations, exposures should be controlled by adjusting the work schedule.

Effects of Low Temperatures. The last phase of the program was conducted during an exceptionally long cold period during the winter of 1961. The welding and study personnel wore heavy winter clothing including gloves, long underwear, coveralls, long sleeve jackets, and rubber shoe covers.

Ambient temperatures during the test work were as low as 10 deg F, usually about 20 deg, but occasionally reached 40 to 45 deg. Two radiant heaters each having 2 kw heating capacity were placed in the tower to moderate the chilling temperatures, particularly necessary when the general exhaust ventilation was used.

On the top tray, and to a lesser degree on the lower tray when the outside air temperature was less than 40 to 45 deg, direct flow on an individual created an uncomfortable cooling effect. This was true even with the radiant heaters in close proximity to the worker. It is probable that most workers would prefer the fumes to the cold air and would not turn on ventilation equipment when such conditions prevailed. In this instance the use of a local exhauster or a circulating fan with low general ventilation as described elsewhere would be recommended.

Between trays there was no sensation of air movement even at an average tower velocity of 37 fpm. Nevertheless, the airflow did create a chilling effect on the feet which could be recognized in a short time when the outside temperature was 10 deg. This occurred even when the radiant heaters were used.

In Table 5 the effect of air temperature and velocity on the sensation of cold during cold weather vessel welding and cutting is shown. This is strictly an empirical device to be used as a guide only and represents subjective feelings of the writers and welders. The approach used is somewhat similar to that used by Siple[9] in development of the Wind-Chill index.

For our purposes, the convective cooling equation was evaluated in terms of cold weather work. Here skin temperature of 91.4 deg as used by Siple was substituted for 95 deg. With the same symbol definitions the equation then becomes:

$$C = 2.1 \sqrt{V} (t_a - 91.4)$$

In Table 5, this equation is solved for various air

TABLE 5 — EMPIRICAL EVALUATION OF EFFECTS OF AIR TEMPERATURE AND VELOCITY ON SENSATION OF COLD

Air temperature, deg F	Q/A = 40	Q/A = 80
	Btu per hour cooling	
68	390	490
59	540	680
50	690	870
41	835	1060
32	985	1250

Rate of cooling, Btu per hr	Sensation
400-500	Hot
500-600	Warm
600-700	Pleasant
700-800	Cool
800-900	Very cool
over 900	Cold

temperatures and average velocities in the vessel. The value of V is not the calculated Q/A but a velocity directly related to the air movement in the work space corresponding to Q/A.

The subjective sensation data are restricted to workers dressed in normal cold weather clothing. It should be noted that with significant air velocity on a man at temperatures below 50 deg complaints of chill will probably occur.

Conclusions

(1) In the vessels studied, control of welding and cutting fumes by general exhaust techniques was found to vary with average air velocity. As general ventilation is increased, fume control on the average is improved. The mathematical relationship between average fume level and general tower ventilation was determined to be $Q/A = 46.43 \log (C_i/C)$

where C_i = Initial concentration of fume (without ventilation), mg per cu.m.
C = Desired concentration of fume (with ventilation), mg per cu.m.
Q/A = average tower velocity, fpm.

This equation can be applied to total fumes or their components.

(2) Air circulation directed through the work zone to dilute the fumes throughout the work space is an effective way of controlling fume levels if used in conjunction with general ventilation. A velocity of about 100 fpm past the work is sufficient. This combination control method will reduce air requirements below those estimated for general ventilation only.

(3) Fume control by local exhaust method is useful in confined spaces particularly when tandem work is involved. There are, however, some practical limitations to this method. Frequent positioning may be necessary for effective utilization, the ducting may block the manway accessibility, and excessive heat exposures will probably not be controlled.

(4) Upflow exhaust is the most effective way of controlling fume from overhead welding. On the other hand, downflow is the most effective manner of reducing fumes from downhand welding. The ventilation scheme selected, upflow or downflow, should depend upon the predominance of the welding operation performed. When no clear cut case is presented, downflow exhaust is suggested.

(5) If the air first has to pass through a restriction, such as bubble trays, before impinging on a man, its fume dissipating properties are seriously diminished. Thus, the general ventilation scheme by itself may not be an economical way of reducing fume in between-tray work. Instead, local exhaust or use of air circulation in conjunction with exhaust ventilation is suggested.

(6) Suggested ventilation rates for fume control may not be valid during periods of low ambient temperatures. Under these conditions lower rates may be employed (20 to 30 fpm average tower velocity), if small fans are used to disperse fumes from the breathing zone of the welder into the work-space. An alternative approach might be the use of a local exhauster.

(7) Excessive environmental heat can develop during welding and cutting operations in confined spaces. With ambient temperatures to 90 deg, ventilation required to control fumes also controlled heat developed during welding. Additional air or supply air cooling would be necessary to maintain desirable work place temperatures for torch cutting over extended periods.

(8) Although in theory nitrogen dioxide can be formed during welding and cutting operations, no detectable quantities were found during the test program.

Acknowledgment

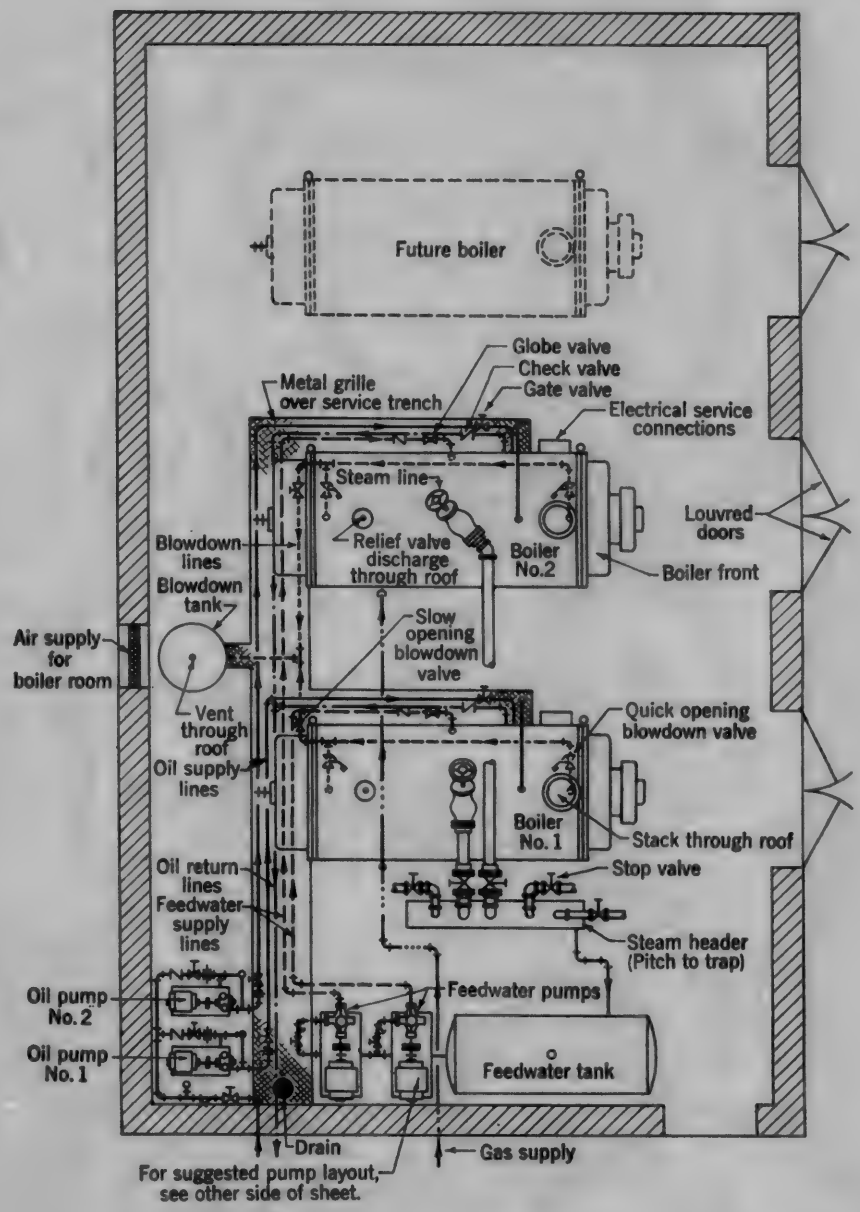
The authors acknowledge the help of F. W. Church of Esso Research and Engineering Company and G. W. Wilkening and F. S. Venable of Humble Oil and Refining Company. Execution of the program was made possible by the interest and cooperation of the Medical and Mechanical Departments of the Manufacturing Division, Humble Oil and Refining Company.

References

1. Tebbens, B. D. and Drinker, P.: "Ventilation in Arc Welding with Coated Electrodes." J. Ind. Hyg. Toxicol. *23*:322-342 (September 1941).
2. Roe, J. W.: "Gases and Fumes Produced in Fusion Welding and Cutting." Ann. Occup. Hyg. *2*:75-84 (1959).
3. American Sandard Safety in Welding and Cutting, Z49.1-1958. Amer. Welding Soc. New York (1958). p. 40-41.
4. "Ventilation and Protection in Welding and Cutting" in Safety and Health Standards for Federal Supply Contracts, 41 CFR 50-204. Fed. Register *25*:13815 (Dec. 28, 1960).
5. U. S. Department of the Navy, Bureau of Ships Manual, Chapter 92, Welding and Allied Processes (Jan. 28, 1949). p. 61.
6. Jones, A. R. and Church, F. W.: "A Criterion for Evaluation of Noise Exposures." Am. Ind. Hyg. Assoc. J. *21*:481-485 (Dec. 1960).
7. Haines,G. F. and Hatch, T.: "Industrial Heat Exposures—Evaluation and Control." Heating and Ventilating *49*:93-104 (Nov. 1952).
8. Yaglou, C. P., et al. "Habitability Studies in Climatic Extremes" Annual Report #9 to the Commission on Environmental Hygiene of the Armed Forces Epidemiological Board, Yuma, Arizona (Feb. 28, 1956).
9. Siple, P. A. and Newburgh, L. H., ed: Physiology of Heat Regulation and the Science of Clothing. W. B. Saunders Co., Philadelphia, (1949) p. 422-423.

TYPICAL BOILER ROOM LAYOUT

for two high pressure boilers fired with oil or gas



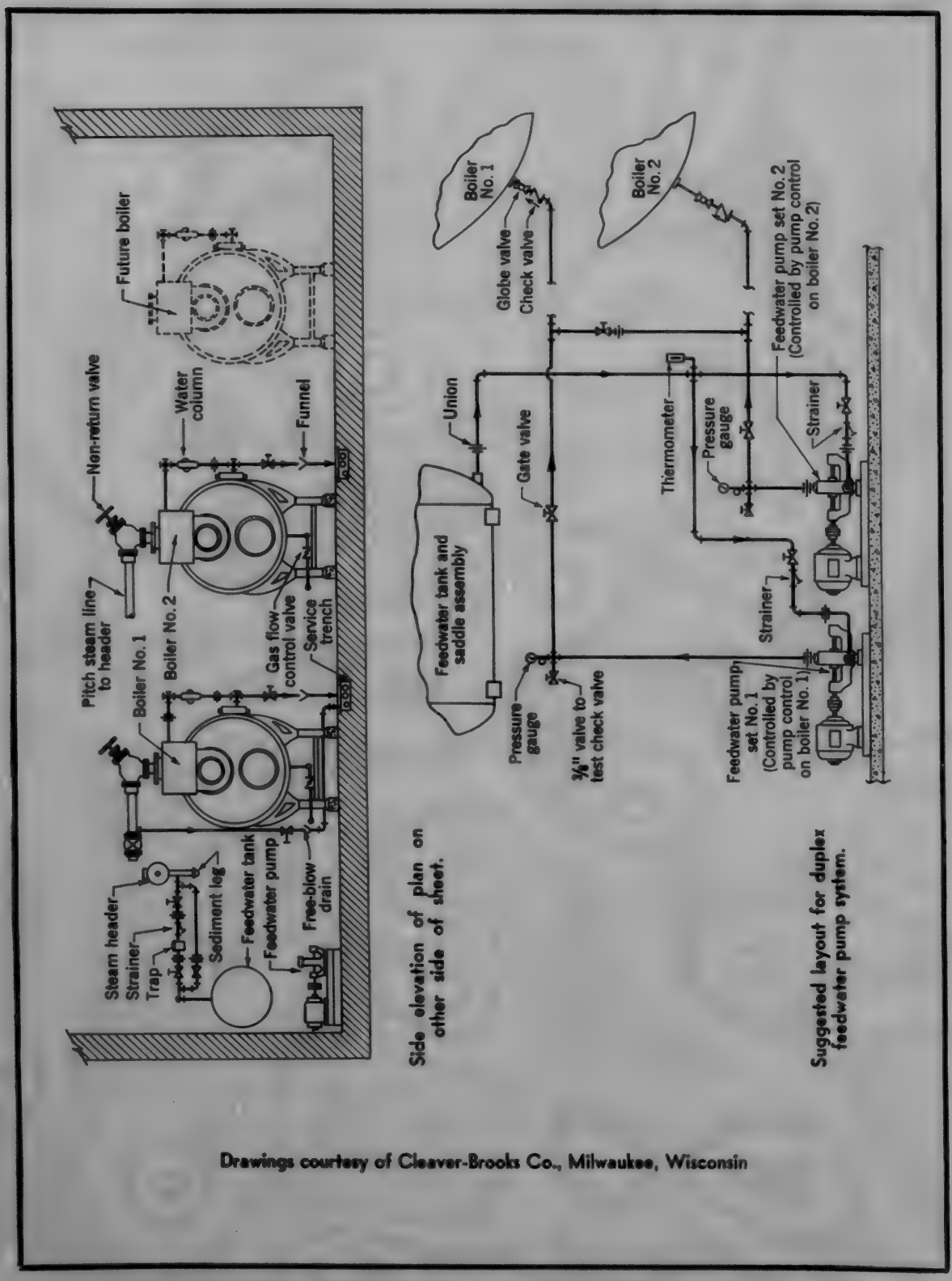
PLAN — for side elevation, see other side of sheet.

DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

September, 1961

TYPICAL BOILER ROOM LAYOUT

for two high pressure boilers with oil or gas



Drawings courtesy of Cleaver-Brooks Co., Milwaukee, Wisconsin

SPACING OF PIPE ON RACKS

This chart, developed by Julius Getlan of Seelye Stevenson Value & Knecht, consulting engineers, New York City, enables one to quickly determine the centerline-to-centerline dimension between any two size pipes on a rack. Select one pipe size at top, another at the side of the table. Where the appropriate columns intersect, the dimension is given.

These factors are included in the dimensions given: OD of flanges and fittings, one-inch insulation over flanges and fittings, and clear space between fittings as follows: One inch between piping 3 inches and smaller, 1½ inches between a pipe 3 inches and smaller and a pipe 4 inches or larger, and 2 inches between piping 4 inches and larger. All fractional dimensions less than ¼ inch were increased to the next larger ¼ inch.

Nominal Pipe Dia, Inches		Nominal Pipe Diameter, Inches											
		¾		1			1¼			1½			
		T	S	T	F	S	T	F	S	T	F	S
		Centerline-to-Centerline Dimension, Inches											
¾	T	4¾	—	—	—	—	—	—	—	—	—	—
	S	4½	4¼	—	—	—	—	—	—	—	—	—
1	T	5	4¾	5¼	—	—	—	—	—	—	—	—
	F	6	5¾	6¼	7¼	—	—	—	—	—	—	—
	S	4¾	4½	5	6	4½	—	—	—	—	—	—
1¼	T	5¼	5	5½	6½	5	5½	—	—	—	—	—
	F	6¼	6	6½	7½	6¼	6¾	7¾	—	—	—	—
	S	4¾	4½	5	6	4½	5¼	6¼	4¾	—	—	—
1½	T	5¼	5	5½	6½	5¼	5¾	6¾	5¼	5¾	—	—
	F	6½	6¼	6¾	7¾	6¼	6¾	8	6½	7	8	—
	S	5	4¾	5¼	6¼	4¾	5¼	6	5	5½	6½	5
2	T	5¾	5½	6	7	5½	6	7¼	5¾	6¼	7¼	5¾
	F	7	6¾	7¼	8¼	6¾	7¼	8½	7	7½	8½	7
	S	5¼	5	5½	6½	5	5½	6¾	5¼	5¾	6¾	5¼
2½	T	6	5¾	6¼	7¼	6	6½	7½	6	6½	7¾	6¼
	F	7½	7¼	7¾	8¾	7¼	7¾	9	7½	8	9	7½
	S	5½	5¼	5¾	6¾	5¼	5¾	7	5½	6	7	5½
3	T	6¼	6	6½	7½	6¼	6¾	7¾	6¼	6¾	8	6½
	F	7¾	7½	8	9	7½	8	9¼	7¾	8¼	9¼	7¾
	S	5¾	5½	6	7	5½	6	7¼	5¾	6¼	7¼	5¾
4	T	7½	7¼	7¾	8¾	7¼	7¾	9	7½	8	9	7½
	F	9	8¾	9¼	10¼	8¾	9¼	10½	9	9½	10½	9
	S	6¾	6½	7	8	6½	7	8¼	6¾	7¼	8¼	6¾
5	T	8	7¾	8¼	9¼	7¾	8¼	9½	8	8½	9½	8
	F	9½	9¼	9¾	10¾	9¼	9¾	11	9½	10	11	9½
	S	7¼	7	7½	8¼	7	7½	8¾	7¼	7¾	8¾	7¼
6	T	8¾	8½	9	10	8½	9	10¼	8¾	9¼	10¼	8¾
	F	10	9¾	10¼	11¼	9¾	10¼	11½	10	10½	11½	10
	S	7¾	7½	8	9	7½	8	9¼	7¾	8¼	9¼	7¾
8	T	9¾	9½	10	11	9¾	10½	11¼	9¾	10¼	11½	10
	F	11¼	11	11½	12½	11	11½	12¾	11¼	11¾	12¾	11¼
10	T	11¼	11	11½	12½	11	11½	12¾	11¼	11¾	12¾	11¼
	F	12½	12¼	12¾	13¾	12¼	12¾	14	12½	13	14	12½
12	T	12¼	12	12½	13½	12	12½	13¾	12¼	12¾	13¾	12¼
	F	14	13¾	14¼	15¼	13¾	14¼	15½	14	14½	15½	14

T denotes threaded IPS pipe. *F* denotes flanged fittings on pipe. *S* denotes soldered or brazed tubing.

Nominal Pipe Diameter, Inches		Nominal Pipe Diameter, Inches											
		2			2½			3			4		
		T	F	S	T	F	S	T	F	S	T	F	S
		Centerline-to-Centerline Dimension, Inches											
2	T	6½	—	—	—	—	—	—	—	—	—	—	—
	F	7¾	9	—	—	—	—	—	—	—	—	—	—
	S	6	7¼	5½	—	—	—	—	—	—	—	—	—
2½	T	7	8¼	6½	7¼	—	—	—	—	—	—	—	—
	F	8¼	9½	7¾	8¾	10	—	—	—	—	—	—	—
	S	6¼	7½	5¾	6¾	8	6	—	—	—	—	—	—
3	T	7¼	8½	6¾	7½	9	7	7¾	—	—	—	—	—
	F	8½	9¾	8	9	10¼	8¼	9¼	10½	—	—	—	—
	S	6½	7¾	6	7	8¼	6¼	7¼	8½	6½	—	—	—
4	T	8¼	9½	7¾	8¾	10	8	9	10¼	8¼	10	—	—
	F	9¾	11	9¼	10¼	11½	9½	10½	11¾	9¾	11½	13	—
	S	7½	8¾	7	8	9¼	7¼	8¼	9½	7½	9¼	10¾	8½
5	T	8¾	10	8¼	9¼	10½	8½	9½	10¾	8¾	10½	12	9¾
	F	10¼	11½	9¾	10¾	12	10	11	12¼	10¼	12	13½	11¼
	S	8	9¼	7½	8½	9¾	7¾	8¾	10	8	9¾	11¼	9
6	T	9½	10¾	9	10	11¼	9¼	10¼	11½	9½	11¼	12¾	10½
	F	10¾	12	10¼	11¼	12½	10½	11½	12¼	10¾	12½	14	11¾
	S	8½	9¾	8	9	10¼	8¼	9¼	10½	8½	10¼	11¾	9½
8	T	10¾	12	10½	11	12½	10½	11¼	12¾	10¾	12½	14	11¾
	F	12	13¼	11½	12½	13¾	11¾	12¾	14	12	13¾	15¼	13
10	T	12	13¼	11½	12½	13¾	11¾	12¾	14	12	13¾	15¼	13
	F	13¼	14½	12¾	13¾	15	13	14	15¼	13¼	15	16½	14¼
12	T	13	14¼	12½	13½	14¾	12¾	13¾	15	13	14¾	16¼	14
	F	14¾	16	14¼	15¼	16½	14½	15½	16¾	14¾	16½	18	15¾

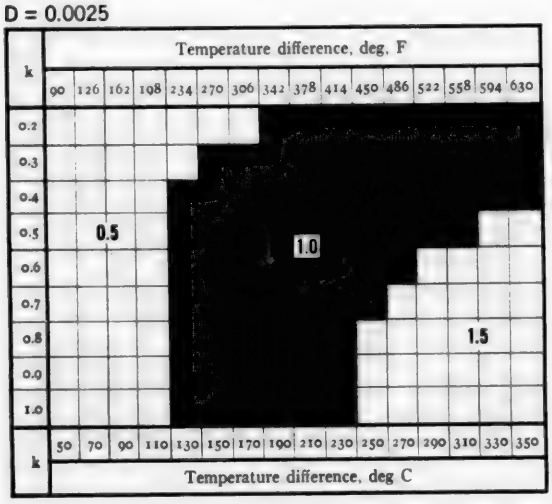
Nominal Pipe Diameter, Inches		Nominal Pipe Diameter, Inches											
		5			6			8		10		12	
		T	F	S	T	F	S	T	F	T	F	T	F
		Centerline-to-Centerline Dimension, Inches											
5	T	11	—	—	—	—	—	—	—	—	—	—	—
	F	12½	14	—	—	—	—	—	—	—	—	—	—
	S	10¼	11¾	9½	—	—	—	—	—	—	—	—	—
6	T	11¾	13¼	11	12½	—	—	—	—	—	—	—	—
	F	13	14½	12¼	13¼	15	—	—	—	—	—	—	—
	S	10¾	12¼	10	11½	12¾	10½	—	—	—	—	—	—
8	T	13	14½	12¼	13¾	15	12¾	14¾	—	—	—	—	—
	F	14¼	15¾	13½	15	16¼	14	16¼	17½	—	—	—	—
10	T	14¼	15¾	13½	15	16¼	14	16¼	17½	17½	—	—	—
	F	15½	17	14¾	16¼	17½	15¼	17½	18¾	18¾	20	—	—
12	T	15¼	16¾	14½	16	17¼	15	17¼	18½	18½	19¾	19½	—
	F	17	18½	16¼	17¾	19	16¾	19	20¼	20¼	21½	21¼	23

How Much INSULATION for Pipes and Flat Surfaces?

Herein is concluded Table 2 for determining economic thickness of pipe insulation. The table was begun in the May Reference Section and continued each month. Data are from "Manual on Economic Thickness of Insulation for Flat Surfaces and Pipes", developed by West Virginia University and Union Carbide Chemicals Company. Only those portions of the Manual most useful to ACH&V readers have been reproduced. The whole Manual is available in an edition published by National Insulation Manufacturers Association, 441 Lexington Ave., New York 17, N. Y., at $8 per copy.

Table 2. Economic Thickness. 3½" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

D = 0.0025



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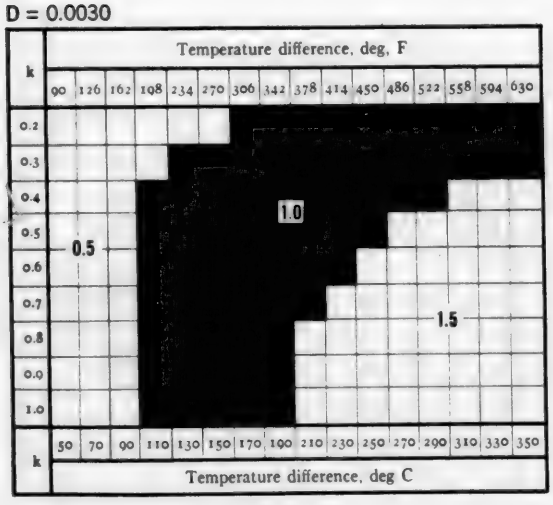
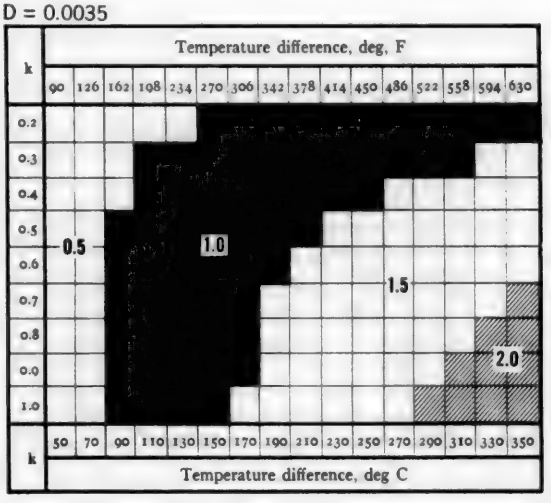


Table 2. Economic Thickness. 3½" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

D = 0.0035



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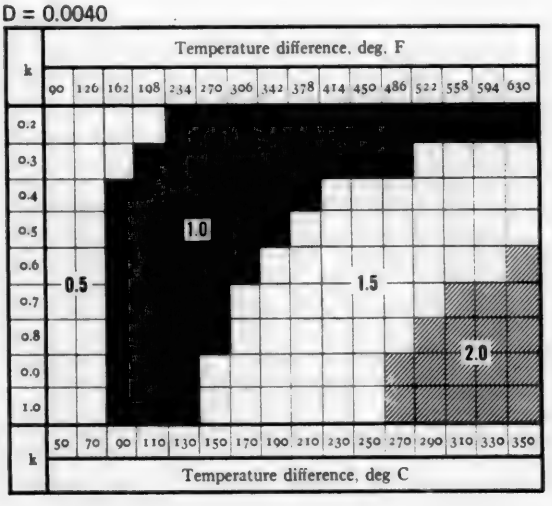

Table 2. Economic Thickness. 3½" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

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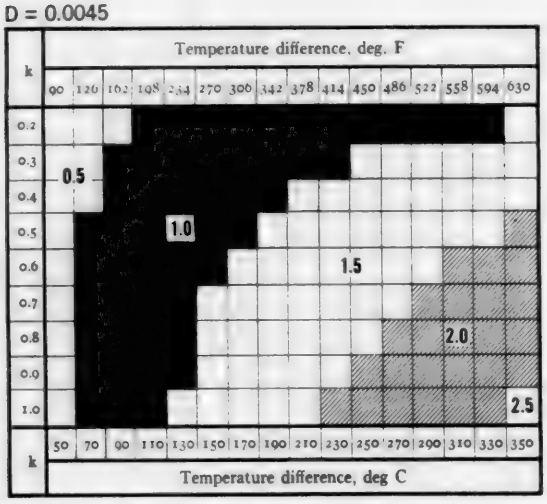

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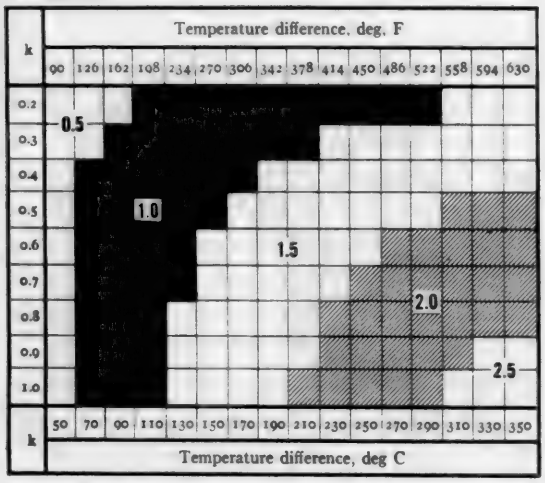

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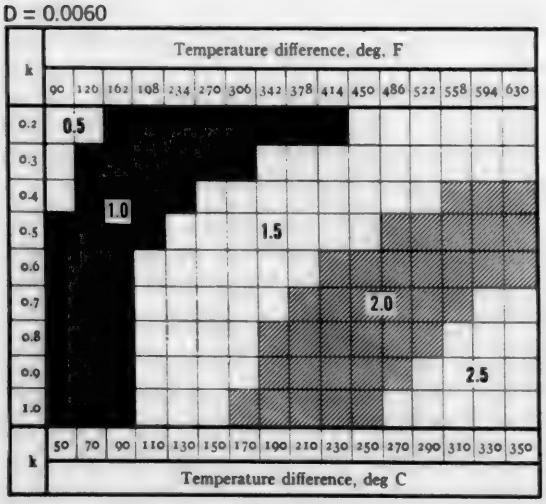

Table 2. Economic Thickness. 3½" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

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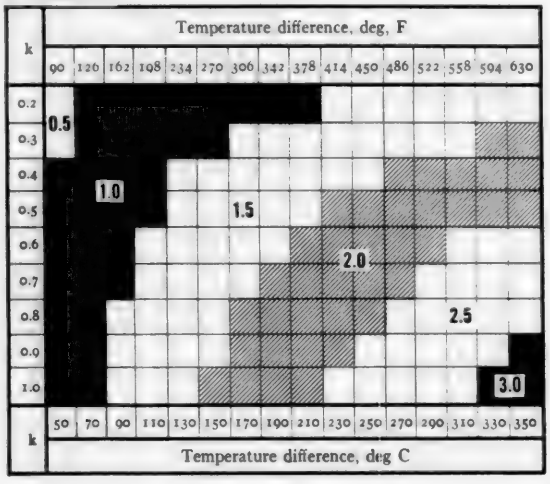

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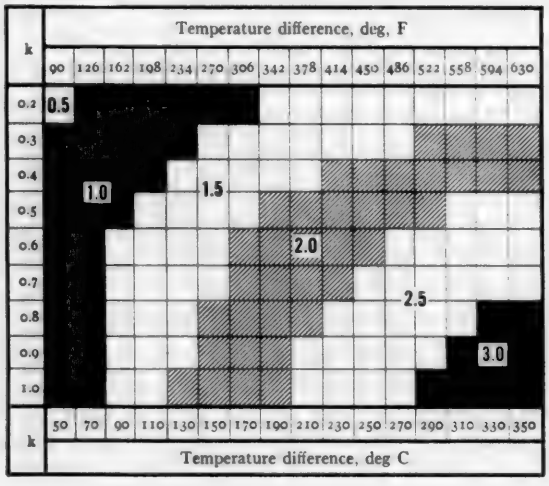

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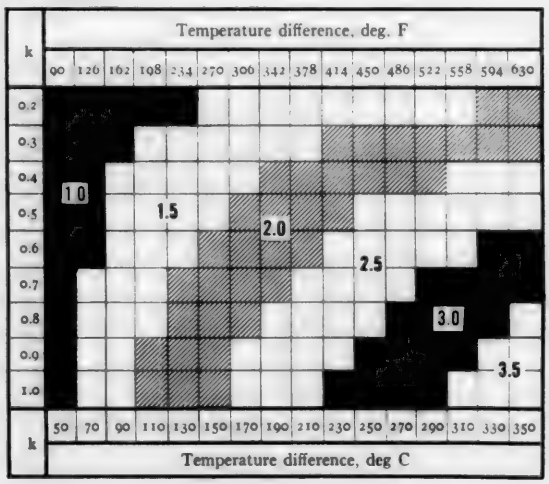

developed at West Virginia University with Union Carbide Chemicals Company.

Table 2. Economic Thickness. 3½" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

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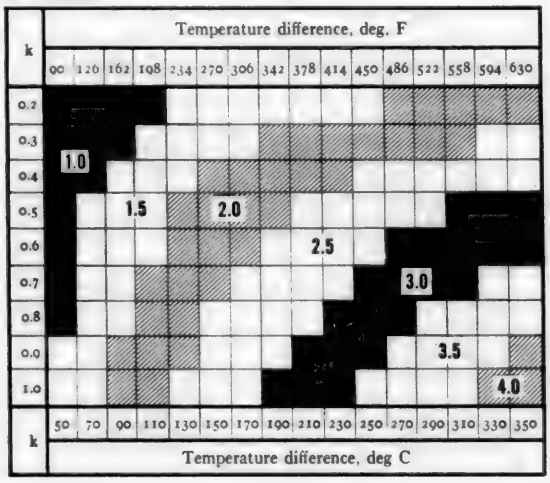

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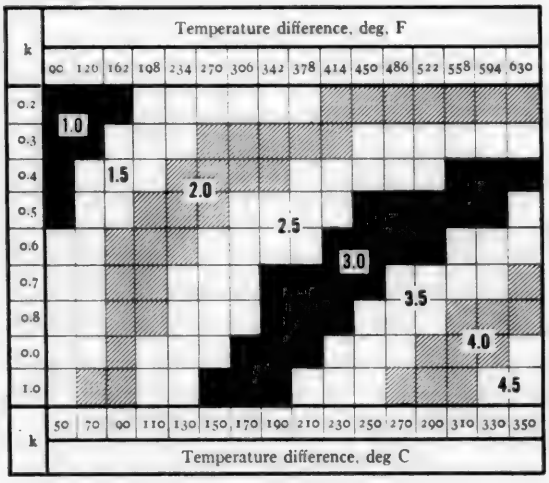

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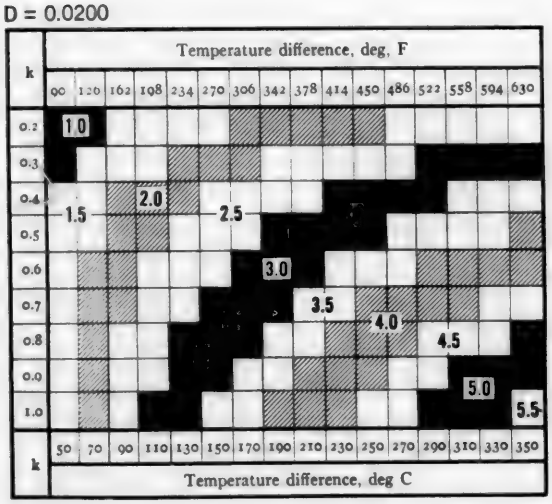
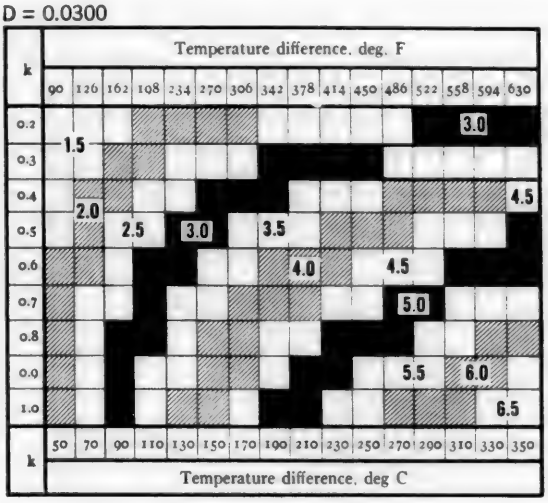


Table 2. Economic Thickness. 3½" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

D = 0.0300



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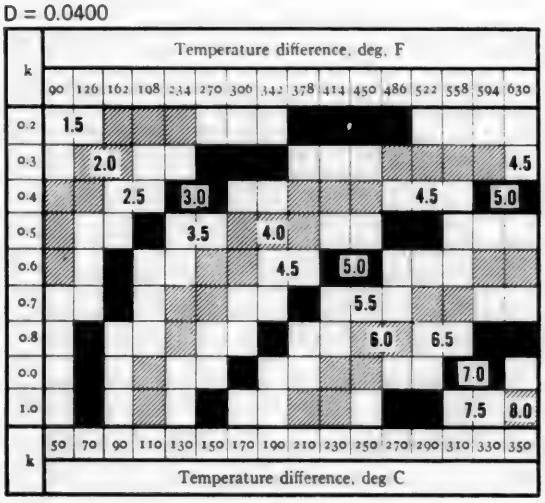

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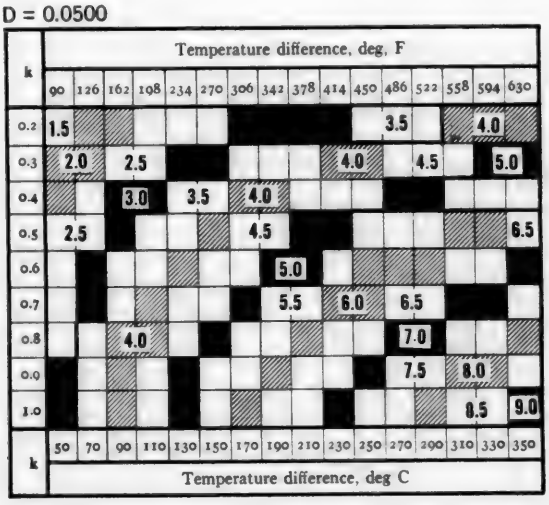

Table 2. Economic Thickness. 4" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

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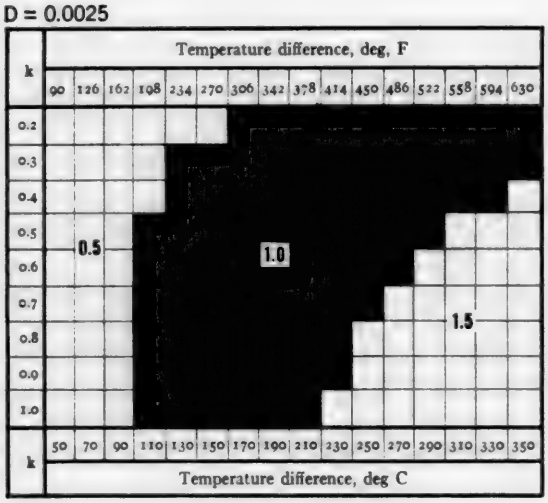
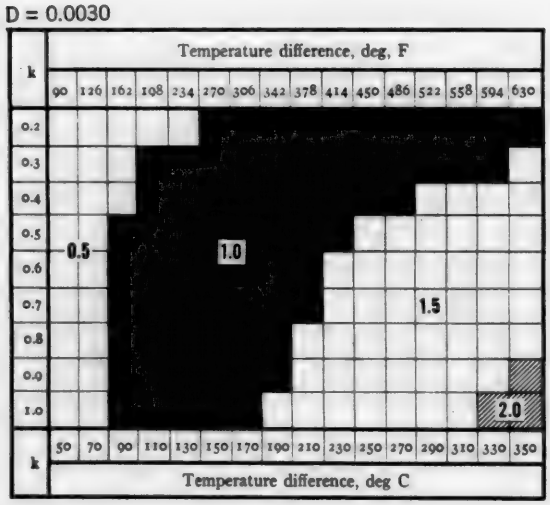


D = 0.0030



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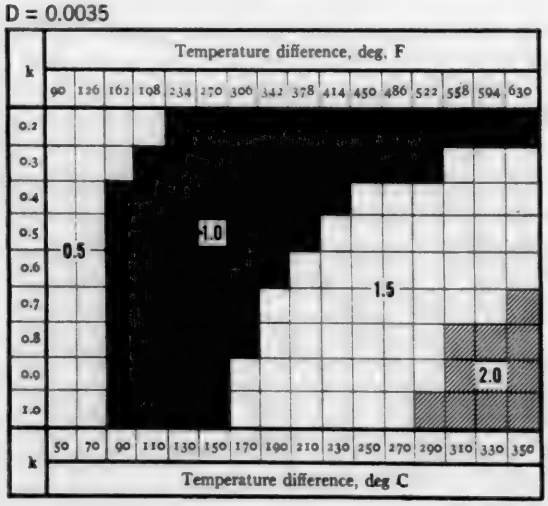

Table 2. Economic Thickness. 4" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

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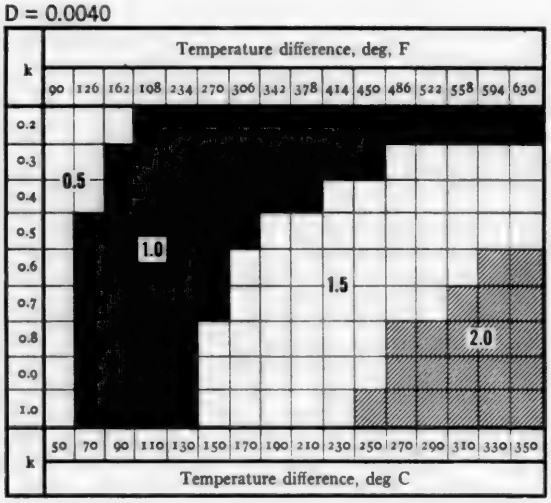

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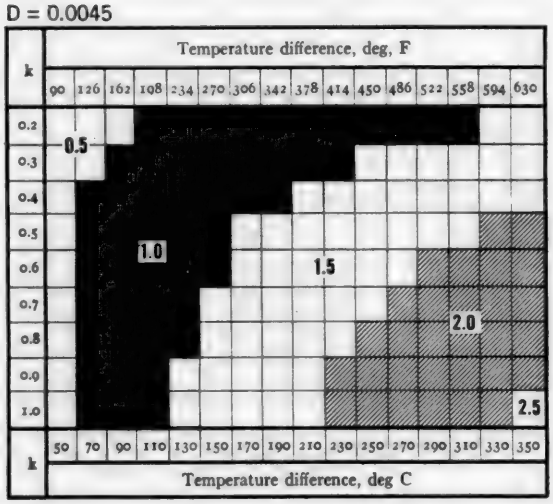

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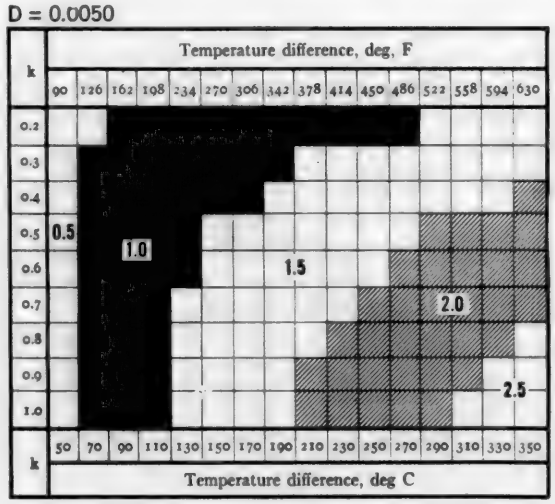

of the May, 1961 issue, which includes full instructions on use of these data.

Table 2. Economic Thickness. 4" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

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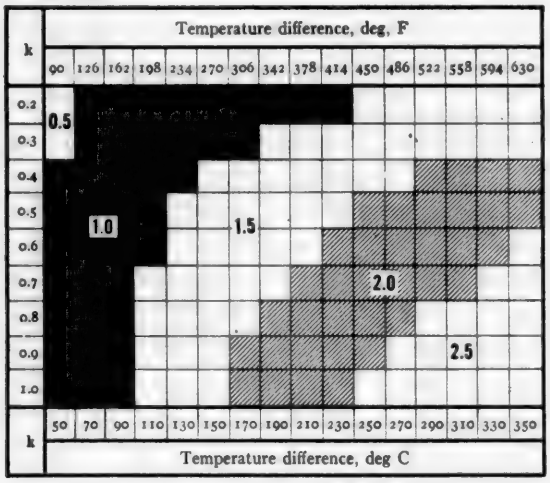

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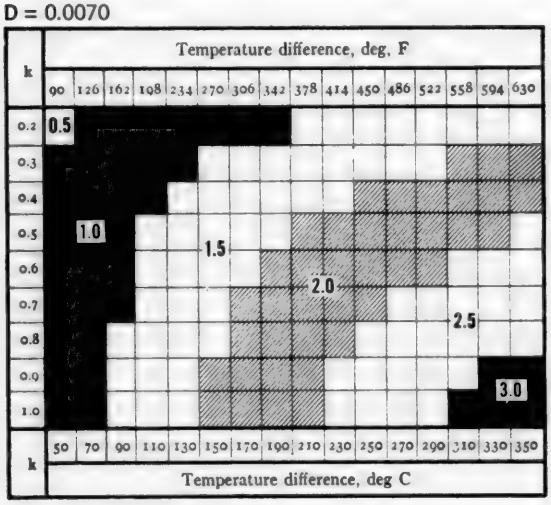

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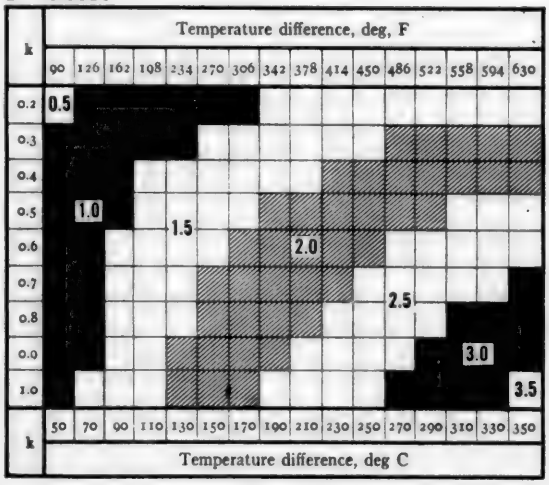

Table 2. Economic Thickness. 4" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

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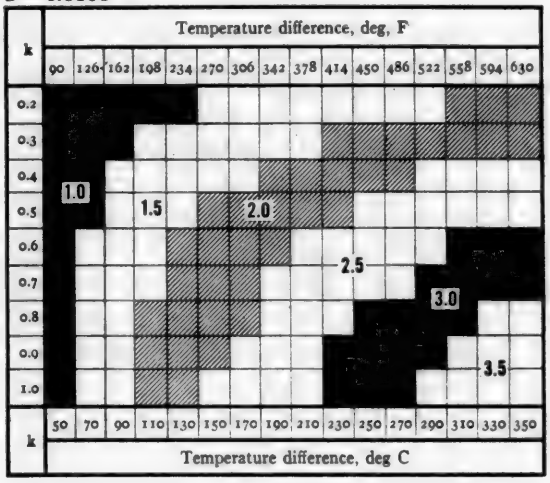

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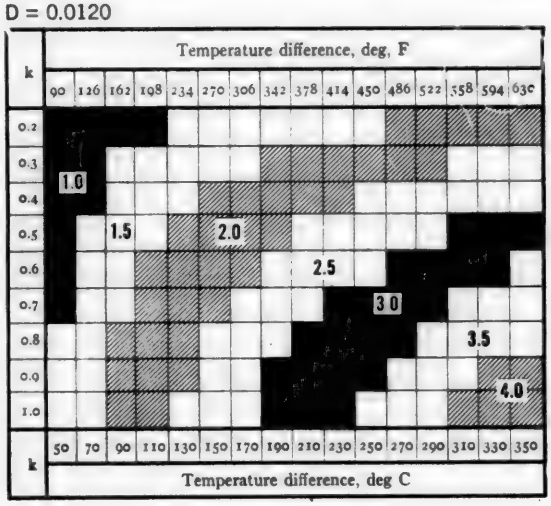

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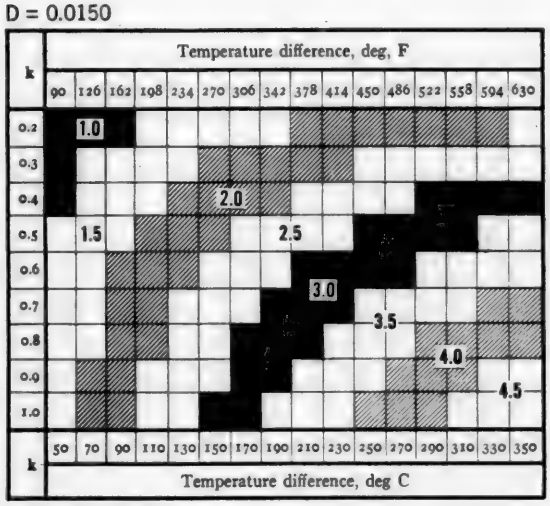

Table 2. Economic Thickness. 4" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

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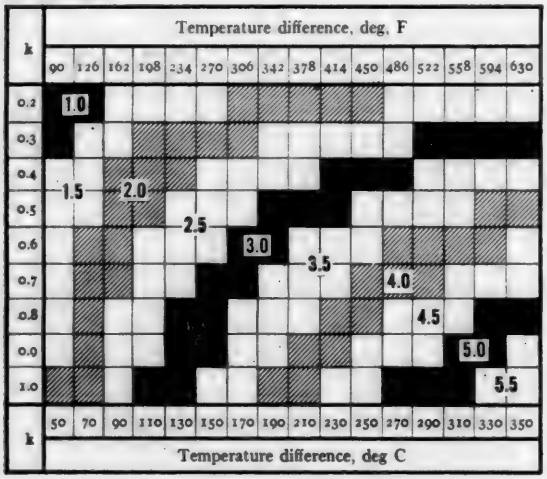
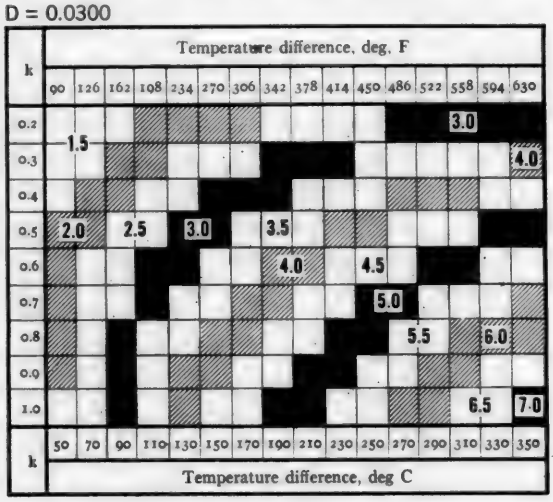


Table 2. Economic Thickness. 4" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

D = 0.0300



Tailor-Made Tables May Save Time

The Manual can be used as the basis of a set of tables made up to the specific requirements of a plant, a portion of an industry, or for any group of insulation applications where the conditions are more restricted than those presented in the Manual.

One factor, for instance, that will remain constant for a large number of cases is the depreciation period assigned to the insulation. Depending on the circumstances, installed cost of insulation for each pipe size, and production cost of steam or hot water, may be relatively constant.

Having selected those factors which can be considered, over a given period of time, as constant, the user may construct new and simplified tables, based on data in the Manual. Thenceforth, the Manual need be referred to as a source of new tables only when the basic conditions change.

Below is a sample tabulation, based on one given in the new NIMA edition of the Manual. A range of pipe sizes has been selected. Installed cost of 1-inch insulation on a 1-inch pipe (the C factor) and the depreciation period of insulation in years (the N_n factor) has been fixed. Thus, for each pipe size, the B value, insulation cost factor, can be found from Table 1.

An arbitrary production cost for steam, for the purposes of this illustration, has also been selected. So has the capital investment cost, per pound of steam. This enables the assignment, with the help of an appropriate Capital Investment Chart (Fig. 1) of the proper D value for each pipe size. Then, for each pipe size, and for a given type of insulation (here, calcium silicate) the economic thickness is found for four different anticipated temperature differences, pipe to air.

Pipe Size, Inches	Insulation Cost Factor, B	Nearest D Value in Table 2	Temp. Diff., Pipe to Air, °F			
			100 (k = .3)	200 (k = .4)	300 (k = .4)	400 (k = .4)
			Economic Thickness, Inches			
½	0.453	0.0200	0.5	1.0	1.0	1.5
¾	0.473	0.0150	0.5	1.0	1.0	1.0
1	0.527	0.0150	0.5	1.0	1.0	1.5
1¼	0.607	0.0120	0.5	1.0	1.0	1.5
1½	0.494	0.0150	0.5	1.0	1.5	1.5
2	0.681	0.0120	0.5	1.0	1.5	1.5

How to Feed Evaporators – 1

The superheat control expansion valve — how charged — heat exchangers — application of the valve — location of the bulb

NO REFRIGERATION SYSTEM can perform efficiently unless the feed of refrigerant to its evaporator is carefully designed. Of first importance is selection of the valve to control liquid flow. Next is the requirement that refrigerant reach the valve in liquid form and at a pressure sufficiently above that of the evaporator to assure flow at the required rate.

Valve is Mis-named

Of the several types of refrigerant feed valves, all are called expansion valves. The discussion here is limited to the "thermal" expansion valve, the most commonly used. See Fig. 1. Its name has given many the mistaken notion that it responds to a particular temperature. Actually, it responds to a pressure difference which is a function of superheat. A Danish engineer told me that, in his country, they are known as "superheat control expansion valves." This is a better designation, one we ought to adopt.

Although superheat controls the valve opening, at any given setting of the valve a fixed number of degrees of superheat results in a fixed flow only at a single evaporator pressure (or temperature). Net actuating force to open the valve is the difference between (*a*) the pressure corresponding to the superheated gas temperature and (*b*) the pressure which corresponds to the evaporating temperature *plus* spring pressure.

To understand this better, imagine a valve set to be fully open at 10 psi difference and closed at 6 psi difference. Given R-22, that would correspond to 4-7 deg F superheat at 40 deg evaporation; 7-11 deg superheat at 0 deg evaporating; and 14-20 deg superheat at —40 deg evaporating; providing the fluid in the bulb is also R-22.

Power Element Charge

In some cases, the power element is filled with enough liquid so that, even when the space above the diaphragm is full of liquid, there is still a little liquid left in the bulb. With this type of charge, called a *liquid charge*, the temperature of the diaphragm part of the valve, relative to that of the bulb, is of no importance.

In the case of the so-called *"gas" charge*, the liquid quantity is limited, so that, above a particular temperature, often 60 deg, all liquid is evaporated. At that point, the pressure in the bulb, no longer corresponding to saturation, will not be sufficient to open

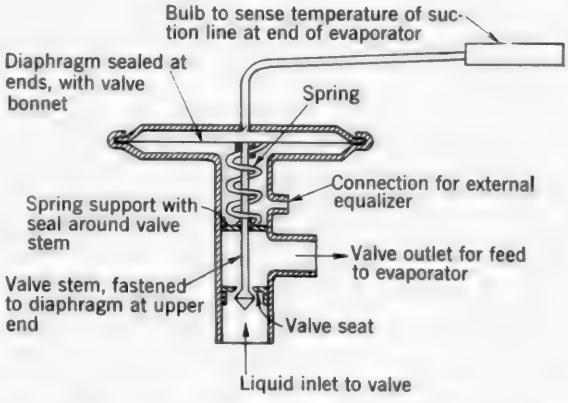

Bulb to sense temperature of suction line at end of evaporator
Diaphragm sealed at ends, with valve bonnet
Spring
Connection for external equalizer
Spring support with seal around valve stem
Valve outlet for feed to evaporator
Valve stem, fastened to diaphragm at upper end
Valve seat
Liquid inlet to valve

Fig. 1. Superheat controlled expansion valve is commonly called "thermal" expansion valve.

the valve. The "gas" charge decreases the chance of excessive overload of the compressor. However, the temperature of the diaphragm part of the valve must be as high or higher than that of the bulb if the bulb is to have any control.

Another type of charge, commonly called the *cross charge*, provides a greater pressure range to operate the valve at low evaporator pressure. Details on this are available from valve manufacturers.

Heat Exchangers

The superheat control expansion valve will control the feed of refrigerant to any one of a number of individual evaporators in a system. Since its only means of control is superheat, a means of superheating refrigerant gas the required amount, without using too much evaporator surface, is required. Thus, it is usually desirable that the warmest part of the fluid being cooled be in contact with the refrigerant as it is nearing the end of its passage through the evaporator.

There are times when the initial temperature of the fluid being cooled is not sufficiently above the desired evaporating temperature to provide the necessary superheat. For example, imagine a system that is chilling water from about 37 deg to 35 deg. The evaporating temperature is about 31 deg. (A lower evaporating temperature would cause the formation of ice, which is not acceptable). With a mere 6 deg

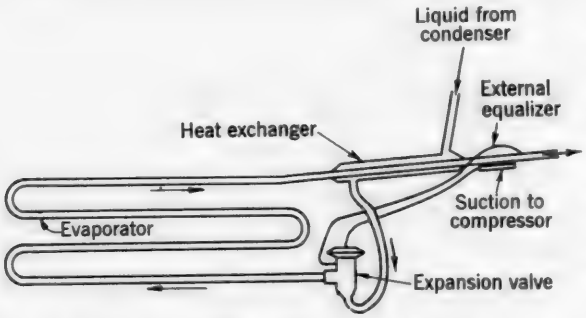


Fig. 2. Heat exchanger uses heat of liquid from condenser to provide superheat for expansion valve.

difference to provide superheat for valve operation, either another type valve must be used or another heat source must be used. When a heat exchanger is used for this heat source, see Fig. 2, the expansion valve bulb is placed on the compressor side of the exchanger. The superheat is provided by the warm liquid.

The heat exchanger must meet certain requirements: (1) The cross-section of the suction passage in the exchanger must not be much larger than the suction line. (2) All of the surface with which the suction gas (or any liquid in it) comes in contact must be heated by the warm liquid. (3) The suction flow in the exchanger must be pitched at least slightly up in the direction of flow. If the flow is more than slightly up, or vertical, the suction cross section should be checked for satisfactory oil return, the same as with any suction line.

Double pipe exchangers, with liquid in the annular space around the suction, and exchangers with the liquid line wrapped around the suction and cast in aluminum, have proven very satisfactory for this service. Superheat control expansion valves, with the bulb charged with the same refrigerant as the system and the bulb located on the compressor side of this type of exchanger, have given satisfactory control of an evaporator over a range from 40 to —40 deg. They will give reasonably good control of the feed to any evaporator if there is the means to provide the necessary amount of superheat for the proper valve operation without using too much of the evaporator surface to do the superheating or requiring a lower evaporating temperature, merely to get sufficient superheat.

In many cases it is inconvenient or impossible to provide the amount of superheat necessary for the operation of the valve with its power element containing the same refrigerant as the system. In that case, the "cross" charges may provide proper operation. If not, another type of expansion valve may be necessary.

Since this type of expansion valve functions in response to superheat, it is applicable only to an evaporator of a type in which variations in the rate of liquid feed will result in a change in superheat at the end of the evaporator (or after the heat exchanger when the expansion valve bulb is on the compressor side of the heat exchanger). For example, the feed to the evaporator in Fig. 3 could not be effectively controlled by a superheat control valve, but the feed to the evaporator in Fig. 4 would be well controlled by that type valve.

Applying the Valve

The pressure under the diaphragm should be the pressure in the suction line at the point where the bulb is located. In a very few cases, the pressure loss, from the expansion valve outlet through the evaporator to the point where the bulb is located, is insignificant. It is then possible to use an *internally* equalized valve. The internally equalized valve has an opening drilled between the space under the diaphragm and outlet side of the valve.

In most cases, pressure loss through the evaporator is appreciable and the *external* equalizer connection, to the point where the bulb is located, is necessary. When in doubt, it is best to use the external equalizer connection. It could be unnecessary but is never undesirable.

It is usually recommended that the external equalizer be connected to the suction line on the compressor side of the bulb. This is done so that a small leak around the expansion valve stem would not affect valve operation by injecting a small amount of liquid just before the bulb. Although I would follow that recommendation, most expansion valves have a rather

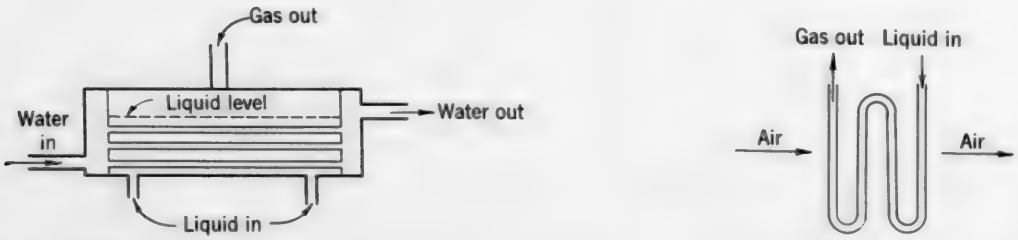


Fig. 3 (left). Evaporator unsuited for superheat controlled expansion valve, but the one in Fig. 4 (right), is.

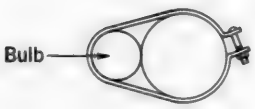


Fig. 5. Location of bulb on relatively small suction line.

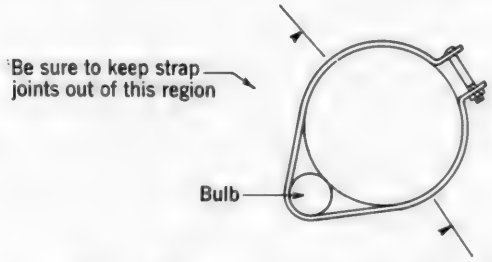


Fig. 6. Bulb is lower on larger suction lines. Strap joints should not be located in region where they would reduce heat transfer.

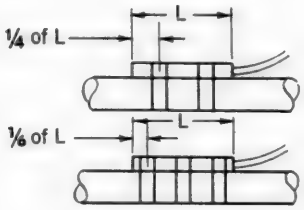


Fig. 7. Straps spaced to provide most effective heat transfer.

tight seal between the valve outlet and the space under the diaphragm, and if the connections happen to be made on the coil side of the bulb, it will probably do no harm. If there is any question, a check of the external equalizer line can be made. If it is warmer than the suction line, the connection before the bulb is causing no ill effect.

Location of Bulb

The bulb should be at the temperature of the gas in the suction line. The presence of any liquid in the suction line at that point where the bulb is should result in a rapid lowering of the bulb temperature. The temperature of the bulb must follow that of the gas with as little delay as possible.

If the bulb is inside the suction line, it should be in such position that no liquid could pass through the suction line without touching the bulb. Any bulb well should be similarly located and the bulb should be a slide fit in the well. An air space between the bulb and the well is undesirable. A liquid fill in the well, when the fit is not close, improves conductivity but results in more lag due to the increased mass which must change its temperature.

When the bulb is externally mounted, the heat path between the bulb and the suction line should be as good as possible. The contact between a cylindrical bulb and the suction pipe cannot be more than a line and is thus a rather poor heat path. Soft copper or aluminum straps of reasonable cross section provide a good heat path. Tape or wire is of practically no value for heat transfer between pipe and bulb.

It is important that any liquid passing through the suction line make its temperature effect felt at the bulb. Thus, the bulb should be near that part of the suction line where liquid may be expected to contact. Since, with externally mounted bulbs, the straps are the important means of heat transfer, the bulb should be as near the point where liquid would be expected to contact as possible—*without* keeping the straps from touching that point. Fig. 5 and 6 illustrate bulb positions for small and large suction lines that meet this requirement.

Location of the bulb on a vertical part of the suction line or on a horizontal section immediately following a vertical upflow, depends on where the liquid will impinge, which is, in turn, dependent on the flow characteristics.

Although two straps are usually used to secure the bulb, three or more are beneficial. The straps should preferably be placed so that each is in the center of its portion of the bulb length, as illustrated in Fig. 7.

The bulb should not be affected appreciably by the ambient surrounding the suction line. Insulation will help reduce the effect, but a heavy mass of insulation in intimate contact with the bulb may, by its mass, make the bulb slower in following the suction line temperature. It is good practice to carry insulation around the bulb but keep a thin air space between the insulation and the bulb. The vapor barrier around the insulation should be practically perfect because otherwise the air space could become filled with water or ice which would increase the lag between the temperature of the bulb and that of the suction line.

It is important to realize that the effect of a pressure change on the valve opening is very nearly instantaneous but the effect of a temperature change is delayed. If the temperature change is large, the delay may be one, two, or more minutes. An increase in compressor capacity which results in a suction pressure reduction of a few psi will open wide the superheat controlled valve. Because the effect of the the temperature change is slower, the valve will feed refrigerant at an excessive rate for a short period, possibly causing liquid to reach the suction line. This may require protection for the compressor.

Additional information on superheat controlled expansion valves will be found in the catalogs. I have had excellent success with this type of valve for refrigerant feed to evaporators. I have seen many cases of very unsatisfactory operation with this type valve. The difference, in practically every case, is not the valve but the application.

Inquiries for more information about the topics already covered in the Seminar or for technical information on other topics in his field, addressed to The Editor, are welcomed and will be forwarded to Mr. Ramsey.

Controlling the Flow of Steam

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Systems Application Engineer, Commercial Division

LORNE NELSON
Senior Research Engineer, Applied Research

RALPH KRAMER
Senior Application Engineer, Chicago factory
Minneapolis-Honeywell

MECHANICAL ENGINEERS have long faced the problem of getting good usable information about steam valves. While the published technical literature has information which might lead to a solution, the material requires ability in servo analysis (the theory of automatic control) plus information on load and time constants which is usually not readily available. The engineer's only recourse has been to leave the valve selection to the valve supplier, hoping a workable solution of valve and controller will be installed. Perhaps this article will contribute to a better understanding of the problem and its solution.

Ordinary Linear Valves

Until a decade ago, the air-conditioning industry generally used ordinary linear valves to modulate steam flow to heating coils. Although a typical valve had a fairly flat curve, it permitted a good deal of steam to pass through under light load. Initial opening of the valve resulted in a rapid increase of steam flow (quick-opening characteristics). After the initial surge, as the valve continued to open, flow changed linearly with travel (Fig. 1).

While the throttling plug was carefully designed, manufacuring tolerances at that time were such that, when the valve disc left the seat, a fairly large quantity of steam shot into the coil. Equipped with good actuators, these valves gave good performance on steam coils until they had to control in the 0–10% lift area, where the control was apt to be erratic.

Equal-Percentage Valves

At a later date, some manufacturers designed and introduced commercial quality equal-percentage valves for hot water and steam applications. Within five years, equal-percentage valves were available from most air-conditioning control manufacturers. Principal control characteristics of these valves were that each equal increment of valve opening increased steam flow by an equal percentage over the previous setting (Fig. 2).

Equal-percentage valves were first designed for unit ventilator applications, generally in schools. Ideally suited for water-supplied unit ventilators, these valves also gave excellent performance on steam-supplied ventilators, probably because, when a

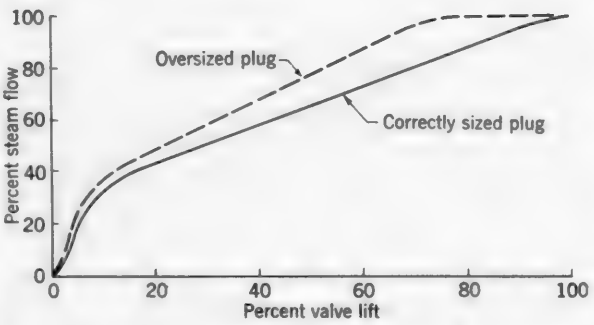


Fig. 1. Typical characteristic curve of old linear valve.

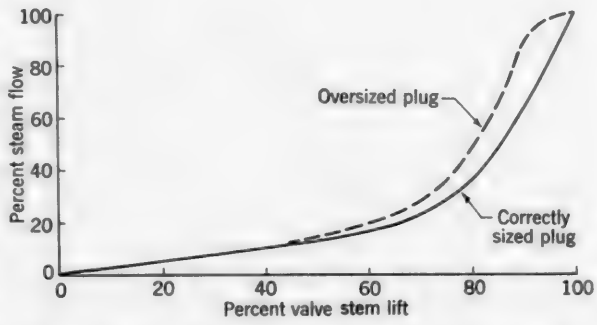


Fig. 2. Typical characteristic curve of equal percentage plug.

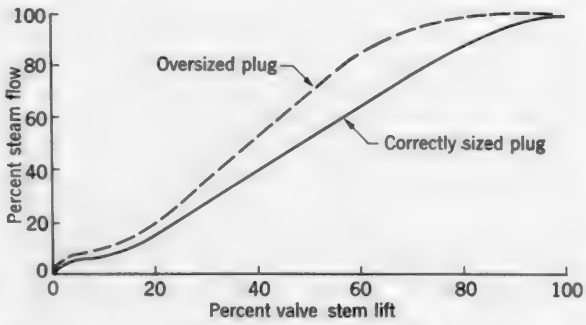


Fig. 3. Characteristic curve of modified linear plug.

Fig. 4. New modified linear valve plug (right) contrasted with ordinary equal-percentage plug shows how valve gives similar opening characteristics, then has a linear curve.

school classroom is occupied, the control valve is nearly closed 50 to 80% of the time, even in the northern part of the country.

As control systems for commercial buildings became more sophisticated and it became common to indicate, log or record duct temperatures at a remote central location it was found that air temperatures leaving steam-supplied heating coils often showed severe fluctuations (hunting).

Modified Linear Valves

Because even correctly-sized equal-percentage valves had a tendency to cause hunting on some jobs during *heavy load* conditions, Honeywell set up an extensive laboratory program and field investigation to determine if an optimum plug characteristic for steam applications could be found. Results of this investigation led to the development of a modified-linear plug (Fig. 3) having the characteristics of the equal-percentage valves for the initial 15% of its travel (near the closed position) and linear characteristics for the remainder of its travel. Contour differences between the equal-percentage and modified linear plugs are shown in Fig. 4.

Causes of System Instability

An investigation of steam valve installations showed the greatest single factor in valve instability was use of oversized valves. Briefly, oversizing is due to the following factors:

(1) Air actually passing through the coil is usually less than shown on mechanical plans.

(2) Required discharge temperature shown on building plans seldom needs to be as high as originally planned.

(3) When the required valve size falls between two available pipe or valve sizes, the larger valve is invariably chosen.

(4) Many engineers refuse to allow sufficient pressure drop through the valve for sizing purposes, which also results in oversizing.

(5) There is a psychological factor: Everyone concerned with system design adds a safety factor to his calculations. By the time the control valve is chosen, selection is based on data much too large in the first place.

Other factors that influence system performance include:

(1) Controller selection, including speed of response and linearity of temperature versus controller output.

(2) Controller location in relation to coil inlet, coil stratification and distance from coil and fan.

(3) Controller throttling range adjustment, which determines gain, hence, system stability.

(4) Speed of response of the steam coil.

(5) Speed of response of the control valve after receiving a signal from the controller.

Design and Installation Criteria

Minimum installation requirements of a valve, coil and trap system (Fig. 5) include, among other things, (1) valve piping large enough so steam pressures do not vary appreciably as the valve goes from fully open to closed. (Coil drop is usually so small that it can be neglected when the coil is under proportioning control, at less than 100% capacity). (2) The trap should be adequately sized and installed with the water leg above it so condensate can drain from the coil by gravity, insuring that there will be no system pressure drop across the trap while operating at reduced coil capacity. (3) Atmospheric returns eliminate variables caused by the vacuum pump cycling or vacuum variations. (4) The equalizer line makes certain that as steam condenses in the coil and as the coil becomes starved of steam, the parts of the coil now occupied by steam will be occupied by air, preventing a vacuum in the coil which might produce erratic results. Steam supply pressure is considered constant for all practical purposes.

Gain Determines Hunting

Ability of a system to control temperatures without hunting depends on the gain (ratio of output to input) of the control circuit (loop); the larger the gain, the greater the instability. This loop gain is the *product* of all the individual component gains.

Top system performance is obtained when individual control components have a constant gain as

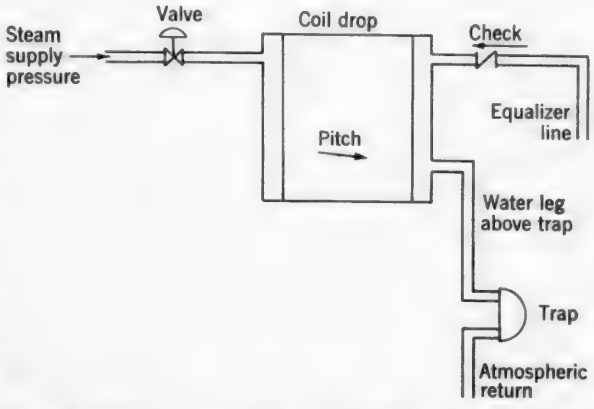


Fig. 5. Minimum requirements of valve, coil and trap installation.

the valve stem travels from one extreme to the other. If the system gain is peaked at a particular valve opening, the controller throttling range (temperature change required to move the valve stem from one extreme to the other) may not be sufficient to prevent hunting.

Increasing the throttling range decreases the controller gain. Increasing the throttling range also means the control system will operate with an increased temperature offset from light to heavy loads.

Comparing controller gain (the change in the control signal or air pressure for each unit change in the control temperature) with the valve opening (Fig. 6) shows that a non-bleed controller has a fairly constant gain, while a bleed controller has a decreasing gain as the valve stem opens.

Both actuator and valve gains (valve gain is defined as the change in steam flow per unit change in control signal, *i.e.* air pressure, to the valve actuator) can be found from valve plug characteristic curves (Fig. 1, 2 and 3). With an oversized plug, the coil becomes saturated with steam before the stem is fully open (dotted lines, Fig. 1, 2 and 3).

Maximum gain occurs at the low lift (light load) condition for an ordinary linear plug (Fig. 7), indicating a tendency to hunt at this condition. For an equal-percentage plug, maximum gain occurs at the high lift (heavy load) condition (Fig. 8), indicating a tendency to hunt during this condition. The new "modified linear" plug curve shows a fairly uniform gain from the closed to the open position (Fig 9).

Under most conditions, steam coil gain (change in control temperature per unit change in steam flow) is constant.

Best performance comes from a combination of valve, controller and steam coil that results in a uniform system gain (product of the valve, controller and steam coil gain) from the closed to the open valve position.

In general, servo and laboratory tests indicate that, with a direct-acting bleed-type temperature controller and a correctly sized equal-percentage plug, the gain of each tends to compensate for the other—the controller gain peaks near the closed valve position, the valve gain peaks near the open position. However, when the valve is oversized, the maximum gain becomes so great that the advantage of the combination is lost.

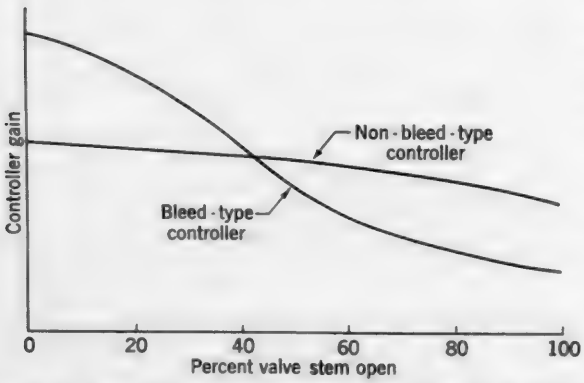


Fig. 6. Typical controller gain as a function of valve stem opening for a direct-acting controller.

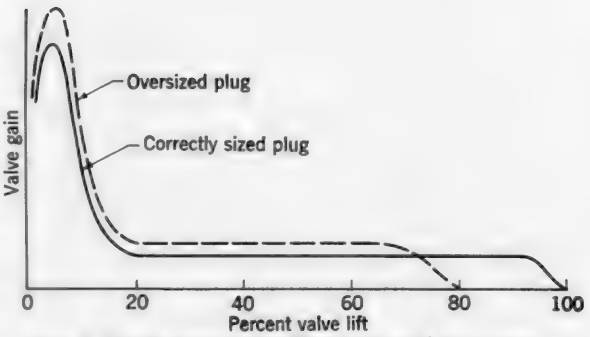


Fig. 7. Valve gain versus lift for the old linear plug.

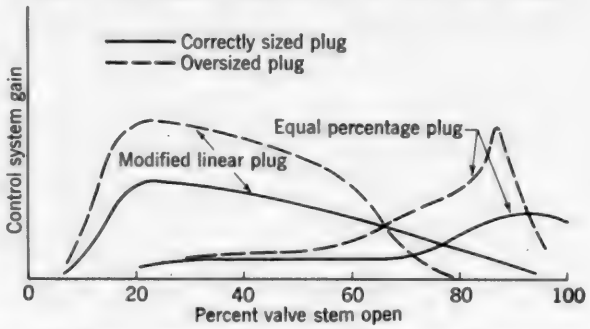


Fig. 8. Typical system gain with bleed-type controller and direct-acting control system.

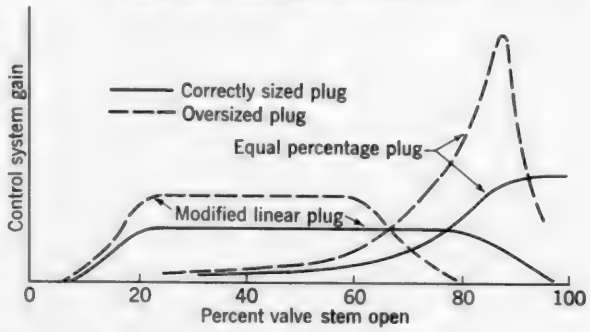


Fig. 9. Typical system gain with non-bleed-type controller and direct-acting control system.

In contrast, the ordinary linear plug (which has a decreasing gain with an increasing valve opening) works poorly with both types of temperature controllers. The flat gain of a non-bleed controller cannot compensate for the decreasing gain of the ordinary linear plug; with a bleed-type controller both gains are high near the closed valve position, meaning even poorer control under light loads.

Conversely, in a reverse-acting system with a bleed-type controller, an ordinary linear plug would give better control than an equal-percentage plug!

Since both the modified linear plug and non-bleed controller have fairly uniform gain from closed to open valve position, optimum system performance can be expected when the two are used, with a reasonably small throttling range, well within the capabilities of most temperature controllers.

(Continued on page 149)

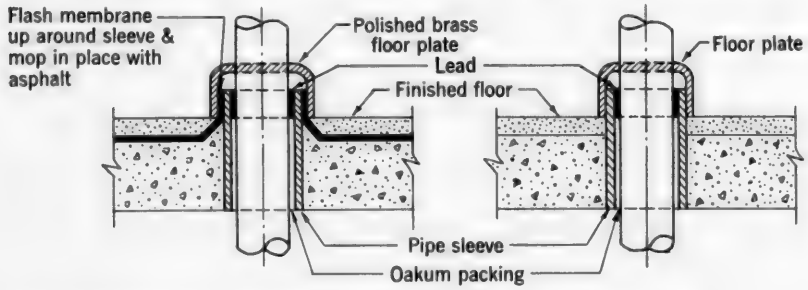
Plumbing Design for an Aerospace Medical Research Center

LAWRENCE GUSS
Design Engineer, Smith, Hinchman & Grylls Associates, Inc.
Architects and Engineers, Detroit, Michigan

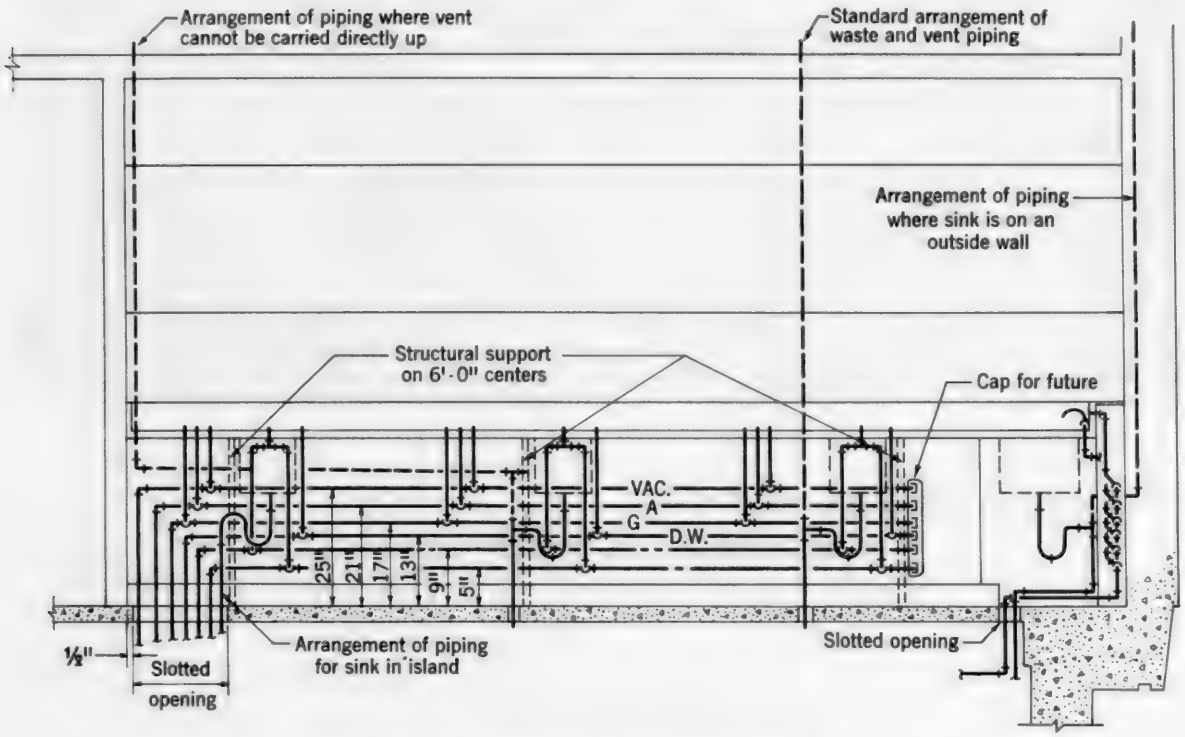
MECHANICAL SYSTEMS for an Aerospace Medical Research Center require much the same considerations found in a conventional group of research buildings except for the special equipment found only in this type of installation and the special wastes from this equipment.

The School of Aviation Medicine at Brooks Air Force Base, San Antonio, Tex., is a good example of this type of institution. The school provides for basic medical and clinical research into Aero-Medical problems of human responses, adaptions, effectiveness and protection under conditions imposed by present and future weapons systems and space vehicles. Human aeromedical problems of selection, training, effectiveness and protection under environmental stresses involving extremes of altitude, temperature, and pressure as well as variations of gravitational forces are studied at the School. The buildings under consideration at this time are:

(1) *Bioastronautics and Biodynamics Laboratory* for study of the human reactions to and the problems encountered living under simulated space conditions. (2) *Bionucleonics Laboratory* for biological and nuclear research to include studies on the potential hazards and safety measures required by Air Force personnel in the use of new weapons, systems and space vehicles. (3) *Cellular Physiology Laboratory* for research into many environmental factors and stresses in Air Force operations, including pressure, weightlessness, noise, vibrations, acceleration, etc., and to determine human reactions to these stresses. (4) *Dental Research Laboratory* for carrying out the entire U.S.A.F. dental research program. (5) *Vivarium Support Facility* for the breeding, care, and standardization of dogs and monkeys for use in research. (6) *Aeromedical Library* and (7) *Professional Building.*



Details of pipe sleeve through membraned floor (far left) and pipe sleeve through conventional floor. Great care was taken in designing sleeves and slots through floor slab to avoid contamination of crawl space area.



Typical arrangement of laboratory piping.

Each building was designed with a crawl space below to accommodate the piping necessary to service it, allowing all piping to be accessable for servicing. Each crawl space has a mechanical equipment room which houses vacuum pumps, air compressors, hot water generators, water softeners, condensate pumps and chilled water pumps. In addition, a mechanical equipment room was provided in the penthouse for air handling units and equipment for manufacturing distilled water. Piping in the crawl spaces of the laboratory buildings was arranged in loops, sized to carry the entire load, with branches to service the individual rooms. This allows for feeding the systems from either direction in case of shutdown of part of any system.

Piping to each laboratory room is valved separately and is up-fed from the crawl space into special recesses. These recesses run behind the casework and house the horizontal piping which feeds each laboratory bench. Thus, access to the piping is had by simply pulling out the casework. Piping is hung on structural supports fastened to the wall with toggle bolts. Ends of the piping are capped for future extention. Great care was taken in designing sleeves and slots through the floor slab to avoid contamination of the crawl space area.

Cold Water System

City water enters the site from two locations. An 8-inch water loop around the entire complex is provided to service the various buildings. Water is available at 100 psig.

Each building is serviced with a branch sized large enough to handle fire protection as well as the domestic water load. The domestic water main is not valved for main shut-off until the branch for fire protection is taken off. The domestic water main is looped in the crawl space of the laboratory buildings to maintain maximum service under all conditions. The piping for the other buildings is much the same as for conventional buildings. All branches are taken off the top of the main, giving a swing joint which has better expansion characteristics.

Since the main pressures were relatively high, the water piping was sized on maintaining a constant velocity in the piping of 5 fps. Chart on page 107 gives the basis for this sizing.

Fixture unit values were assigned to each fixture not running continuously and gallon per minute values assigned to each piece of equipment requiring a continuous flow of water. From these values, with the aid of chart, the entire system was sized. Where branches were feeding a group of fixtures which did not include water closets, the chart for sizing the hot water piping was used.

Pipe Size, Inches	Cold Water Demand			
	Fixture Units		Gpm	
	Min.	Max.	Min.	Max.
½	—	—	3	5
¾	—	—	5.5	9
1	—	—	10	15
1¼	—	—	16	23
1½	—	19	24	35
2	20	74	36	59
2½	75	109	60	89
3	110	554	90	145
4	545	1250	146	240

Pipe Size, Inches	Hot Water Demand			
	Fixture Units		Gpm	
	Min.	Max.	Min.	Max.
½	3	5	3	5
¾	6	12	5.5	9
1	13	21	10	15
1½	22	37	16	23
1½	38	69	24	35
2	70	172	36	59
2½	173	222	60	89
3	223	624	90	145
4	625	1250	146	240

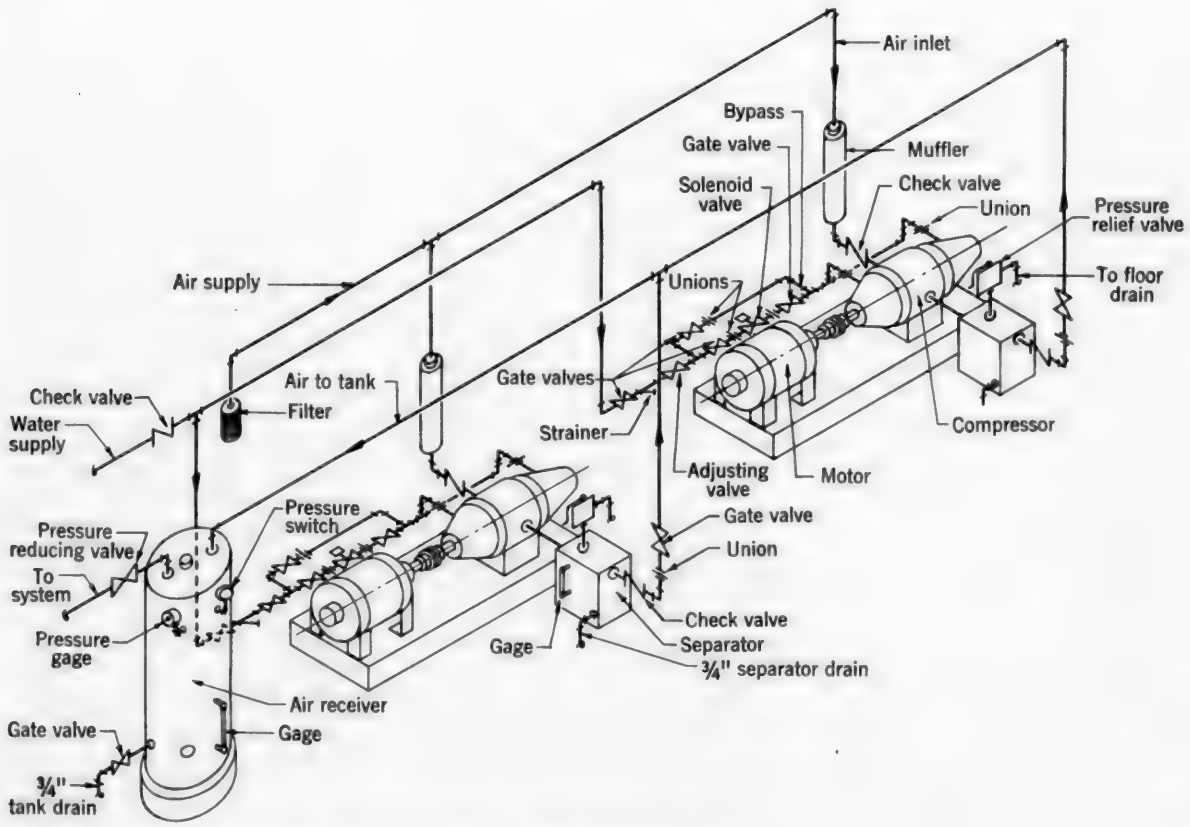
The material for the site water mains is class 250 mechanical joint cast iron pipe and the material for the piping inside the building is Type *L* copper with soldered joints.

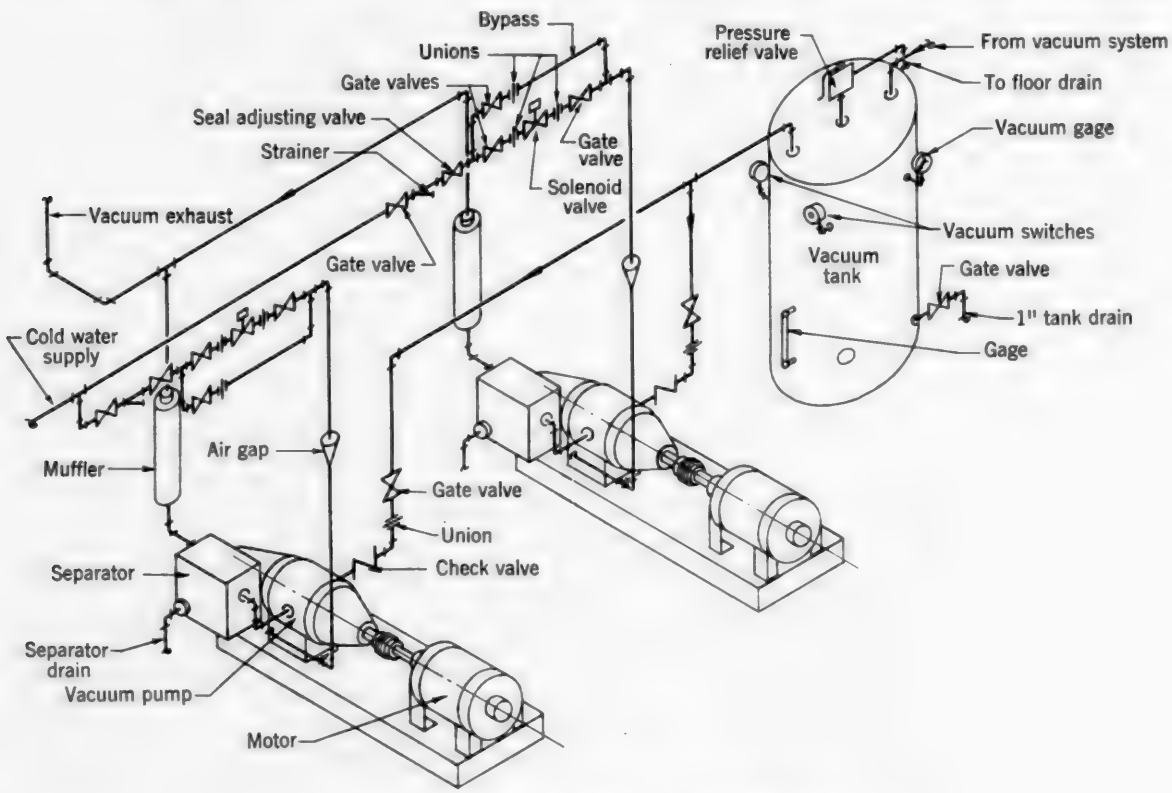
Hot Water Systems

Hot water piping is arranged and valved similar to the cold water piping. The pipe sizing is also similar to that for cold water. The chart below, left, was used.

The hot water generator is of the storage type with a steam heated tube bundle for maintaining the desired temperature. The generators were sized by assigning a gallon-per-hour value to each fixture requiring hot water and multiplying the number of fixtures by this value to arrive at a total gph figure for each building. The storage size for the generat-

50-psi compressed air is supplied by system shown below.





Isometric diagram of laboratory vacuum system.

or was obtained by multiplying this total gallon per hour figure by 35% and the recovery size for the generator was obtained by multiplying the total gph figure by 20%.

An additional instantaneous booster type hot water generator provides 180-deg F water to the laboratory glassware washing areas. The hot water booster was sized to deliver the hot water instantaneously; that is, in terms of gallons per minute, rather than gallons per hour. Each fixture requiring this water was evaluated in terms of its instantaneous requirements.

The material for the hot water piping is the same as that for cold water.

Distilled Water System

Each laboratory building was supplied with a system of distilled water including a 50-gal steam-operated still and a 350-gal stainless steel storage tank. Distilled water was piped to each of the lab rooms for distribution to special faucets on the benches. In addition, distilled water was piped to the glass-washing areas.

Stills and storage tanks were located in the penthouse mechanical equipment rooms so that gravity flow could be obtained. The supply main was carried down to the crawl space for distribution in a manner similar to the cold water and hot water. As very little pressure head was available, the piping had to be sized larger to minimize friction loses. The storage tank was made exceptionally large because the glassware washers require large volumes of distilled water for their final rinse. Piping is stainless steel.

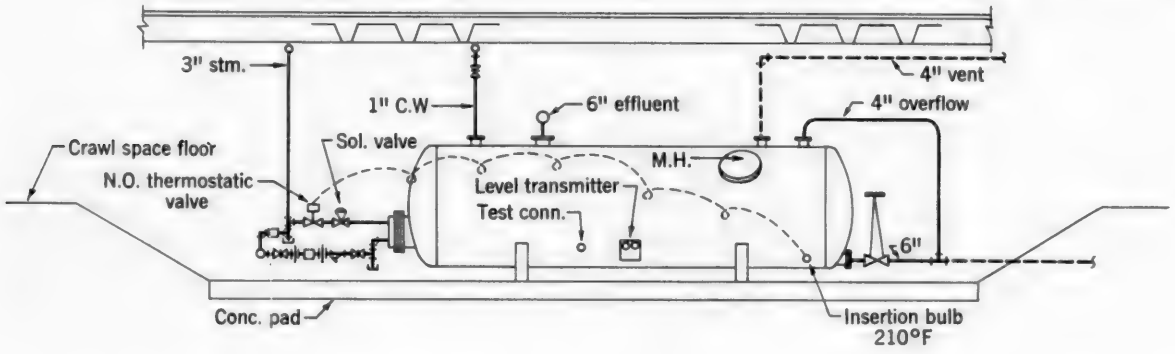
Natural Gas System

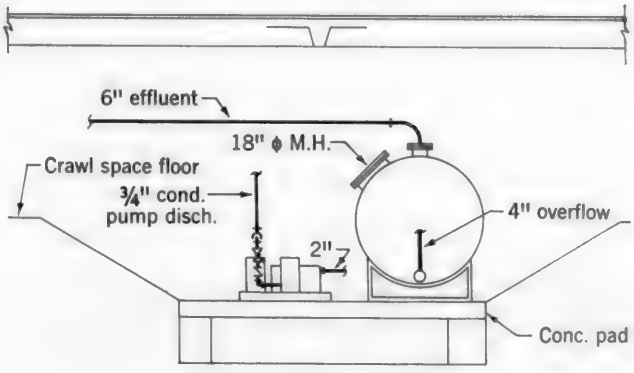
Natural gas is available on the site at 20 psig for distribution to the buildings. A 2-inch loop was provided on the site and each building is furnished with a 1¼-inch branch. Pressure regulators are located outside the buildings and reduce the pressure to 0.6 inches w.c. Natural gas is required in the buildings for emergency generators, pathological incinerators and laboratory bunsen burners.

From the pressure regulator the gas was piped to the crawl space for distribution in a loop system similar to those previously discussed. Information on the gas requirements for the emergency generators and the pathological incinerators was available from the manufacturers and the bench outlets were assumed to require 7 cfh per outlet with 50% usage factor. Design of the piping system allowed for giving a minimum of 0.4 inches w.c. at points of use. Black steel pipe with threaded joints was used.

Compressed Air System

Duplex pumping units, each sized to carry the entire load,





Front and side elevations at stainless steel holding tanks which receive wastes from the nuclear section of laboratory.

were furnished for each laboratory building to deliver 50-lb compressed air. The pumping units are the rotary liquid seal type which delivers clean air, entirely free of dust or oil, to the various outlets. The pumps discharge into a control tank which guarantees a constant pressure in the piping system at all times. The pumping units and receiver are located in the crawl space mechanical equipment room, making them very close to the point of use. A pressure reducing valve was furnished to reduce the pressure to a level consistant with the requirements of the building.

The piping system design was based on each outlet requiring 1 cfm of air with 50% usage factor. The piping material was Type *L* copper with soldered joints.

Laboratory Vacuum System

The vacuum system was also designed with duplex pumping units, each sized to carry the entire load and each capable of pulling 20 inches of mercury vacuum. The pumps are also the rotary liquid seal type and, together with the receiver, make up a unit which will give continuous suction without pulsation. The exhaust from the vacuum pumps discharges outside the building to minimize the possibility of contamination and odors. Waste water from the pumps is piped directly to the sewer system with an air gap on the water supply.

Piping was arranged in the typical manner and was sized on the basis of each outlet requiring cfm with 40% usage factor. Piping is Type *L* copper with soldered joints.

Special Waste Systems

Three areas in this group of buildings have been classified as special *hot* areas, the wastes from which must be collected and sampled before they can be discharged into the sewer system. (1) The Cyto-Chemistry Section in the Cellular Physiology Laboratory, which deals with exposure of animals to various unusual gases which may be encountered in space travel, (2) The Biological Section of the Bionucleonics Laboratory, which deals with the viable organisms and their effect on plants and animals and (3) a part of the Nuclear Section of the Bionucleonics Laboratory, which deals with radioactive isotopes.

Wastes from the Cyto-Chemistry Section discharge into a stainless steel holding tank, 5 ft. by 16 ft. long with a 2,500-gal capacity to retain a one-week supply of waste. This tank was placed in series with another similar tank to which waste from the first tank was connected. Wastes from both tanks are to be sampled, diluted and/or neutralized. The non-contaminated wastes are to enter the sewer system only from the second tank. A means of flushing was provided to that cleaning can be done after each type of material used. Both tanks are located in the crawl space and are complete with manholes, 1-inch test connections, 2-inch overflows, local liquid level gages and remote-reading liquid level gages.

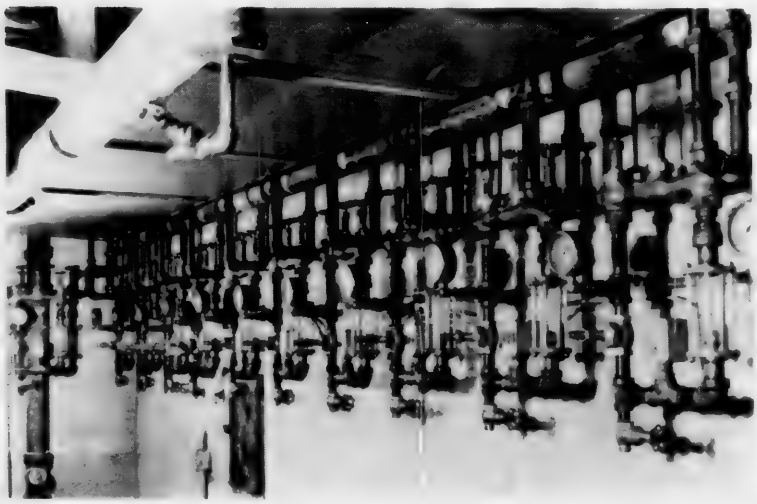
Wastes from the Biological Sec-

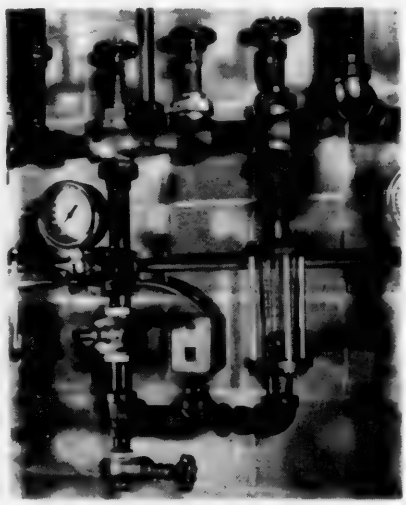
tion discharge into a stainless steel holding tank 5 ft. dia by 16 ft. long with a 2,500-gal capacity to retain a 3-day supply of the wastes leading to it. Material held in this tank is to be boiled until tests indicate that the viable organisms have been reduced sufficiently to safely permit discharge to the sewer system. It appears that a 6-hr boiling period may be required to reduce the organisms to a safe level. Normally, the boiling period is at a time other than during the hours of the normal work day. The tank design is similar to the tanks for Cyto-Chemistry except that a steam-operated tube bundle has been provided to raise the temperature to the desired level. A thermostatically controlled valve and an electric solenoid valve have been installed on the steam supply. The electric solenoid valve is manually operated from above, while the thermostatic valve limits the temperature in the tank to 210 deg F.

Wastes from the nuclear section discharge into two stainless steel holding tanks 6 ft dia by 18 ft long with 4,000-gal capacities to retain a one-week supply of wastes leading to it. Wastes in both tanks are to be sampled, monitored for radioactivity, and diluted. When the wastes in the second tank are at a low enough level of radioactivity they may be discharged into the sanitary sewer system. Should dilution not be sufficient or the level of activity too high for discharge, the effluent will be drained from the tanks and disposed of in accordance with A.E.C. requirements. Tank design is similar to the tanks for Cyto-Chemistry.

Waste and vent piping serving all of the laboratory rooms is Pyrex Double Tough Drainline with compression type couplings and Teflon liners.

Ball Flow Indicators Speed Heat Circuit Balancing





BY USING FLOW INDICATORS to measure the flow rate of hot water while determining temperature with gages, heating circuits can be brought into a correct Btu balance in the system developed by Joseph P. Wohlpart Associates, consulting engineers, New York City. This new method is reported to be both accurate and inexpensive.

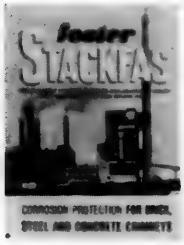
Each heating circuit seen in photo serves a given number of rooms with the hot water required to maintain a desired room temperature range. The amount of hot water fed into each of the circuits is calculated initially from a Btu balance which depends upon the type and location of the rooms, their exposure, etc. The Btu balance depends on more than the temperature of the hot water alone; the flow rate is equally essential. The Wohlpart system takes this into account by adding ball type flow indicators manufactured by Schutte and Koerting Co., Cornwells Heights, Pa., to measure the flow while temperature gages are retained in each circuit. Used in conjunction with one another, the indicators and gages provide much greater accuracy than had been possible with previous systems.

Without flow indication, the contractor attempted to regulate this Btu balance while one element of the heating equation was unknown. He had only a temperature gage, accurate to within 2 or 3 deg F. And, since the differential in the temperature of water piped to and from the boiler is only 20 deg, the percentage of error was great, and adjustments difficult and time-consuming.

With the new system, both flow and temperature are known and a balance can be effected quickly.

NEW LITERATURE

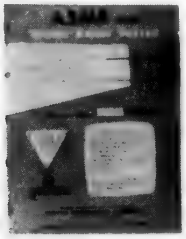
Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.



Corrosion Protection for Stacks

Stackfas, a product to protect new chimney construction and minimize maintenance in new and old chimneys, is described in Brochure SF, published by Benjamin Foster Co., Philadelphia, Pa. Charts, graphs, and photographs illustrate this method of corrosion protection.

Circle **Item 1** on Inquiry Card



Relief Valves

Two 8-page brochures, one featuring combination temperature and pressure relief valves, the other ASME-rated pressure-only relief valves, are offered by Watts Regulator Co., Lawrence, Mass. Both brochures include installation diagrams and complete rating tables.

Circle **Item 2** on Inquiry Card

Pneumatic Temperature Transmitter

A pneumatic temperature transmitter, Type 12A, is discussed in a 12-page bulletin offered by The Foxboro Co., Foxboro, Mass. Design features are emphasized as well as detailed specifications, operating principles, tables of temperature ranges, and related accessories.

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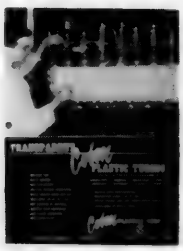

Plastic Tubing

A 12-page catalog describing a broad range of plastic tubing and fittings for many different applications is made available by Cobon Plastics Corp., Newark, N. J. Many types of plastic tubing for high or low pressure use and special applications are described.

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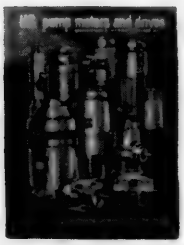

Pump Motors and Drives

Data on motors in the pumping field are made available in 20-page Bulletin F-2002, published by U. S. Electric Motors, Inc., Los Angeles, Calif. Bulletin includes illustrations, descriptions, and condensed specification data on various pump motors and drives.

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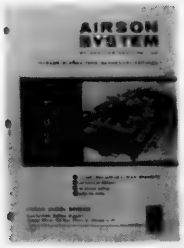


Ceiling Air Distribution

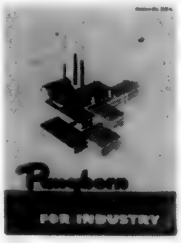
A 4-page bulletin describing the Airson System of ceiling air distribution is made available by United States Gypsum Co., Chicago, Ill. Bulletin explains what system is, how it operates, and gives general specification and materials needed for installation.

Circle **Item 6** on Inquiry Card

Guide for Sales Meetings

"A Guide for Successful Sales Meetings," a 12-page brochure published by Bell & Gossett Co., Morton Grove, Ill., tells how to make the most of sales meetings by careful preparation and thoughtful attention to details. Complete step-by-step procedure is given.

Circle **Item 7** on Inquiry Card



Dust Control

A number of effective methods for controlling industrial dust and fumes are described in 20-page Bulletin 922A by Pangborn Corp., Hagerstown, Md. Includes explanation of advantages of proper dust control, and basic essentials of a typical dust control system.

Circle **Item 8** on Inquiry Card

Air Conditioner Fact File

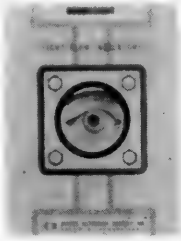
Airflow Co., Rockville, Md., makes available the first group of specification data on its products. The Fact File, a standard sized folder, contains specifications of all models; additions to the file will be mailed periodically giving details on each model.

Circle **Item 9** on Inquiry Card

Gas-Fired Duct Heaters

A 4-page bulletin, GA-61, offered by L. J. Wing Mfg. Co., Linden, N. J., describes gas-fired duct heater assemblies for complete or supplemental heating of large buildings. Gives advantages, drawings, dimensions, capacities, mounting height and coverage data.

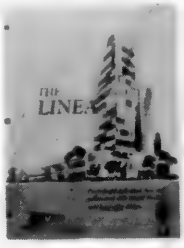
Circle **Item 10** on Inquiry Card



Sight-Flow Indicator

A line of flow indicators, designed to meet the requirements of the chemical processing industry, is presented in 6-page Bulletin 820 by Brooks Instrument Co., Inc., Hatfield, Pa. Specifications include pressure and temperature ratings, gaskets, materials, and flanges.

Circle **Item 11** on Inquiry Card



Roof Exhausters

A 6-page bulletin published by Penn Ventilator Co., Inc., Philadelphia, Pa., describes its line of roof ventilating equipment, including centrifugal, axial, and gravity roof exhausters and accessories. Design features, specifications, and performance tables are included.

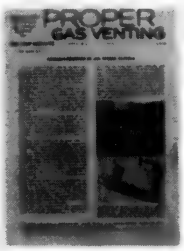
Circle **Item 12** on Inquiry Card

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Prefabricated Conduit Systems

The Durant Insulated Pipe Co., Palo Alto, Calif., announces a 20-page manual described as a new idea in catalogs. Purpose is to present data that will aid the design, specifying, ordering, and installation of the most desirable and logical prefabricated conduit systems.

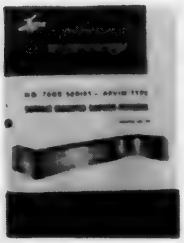
Circle **Item 13** on Inquiry Card



Corrosion-Resistant Gas Vents

Corrosion-resistance of gas venting materials is the subject of this bulletin dealing with safe, modern methods of gas vent installation. Published by Gas Vent Institute, Chicago, Ill., it describes corrosion-resistant properties of double wall gas vents.

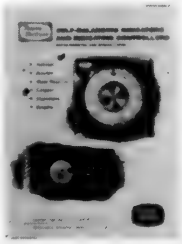
Circle **Item 19** on Inquiry Card



Shower Fixtures

Multi-station shower fixtures for school and industry are the subject of a 26-page folio offered by The Logan Mfg. Co., Glendale, Calif. Complete specifications and features of the fixtures are listed as well as typical shower room arrangements and designs.

Circle **Item 14** on Inquiry Card



Indicators and Controls

Thermo Electric Co., Inc., Saddle Brook, N. J., has released 4-page Bulletin 67, describing its new indicators and indicating controls. Bulletin explains operating principles, control features, applications, installations, servicing ease, and special design features.

Circle **Item 20** on Inquiry Card

Removable Bundle Heat Exchangers

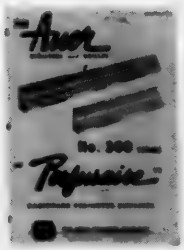
A line of removable tube bundle heat exchangers having an externally packed floating head is described in a 6-page folder, Bulletin 0-1162, published by Basco, Inc., North Tonawanda, N. Y. Sizes, dimensions, and other specifications for the exchangers are fully covered.

Circle **Item 15** on Inquiry Card

Pump Fundamentals

A 16-page booklet available from Goulds Pumps, Inc., Seneca Falls, N. Y., gives an elementary discussion of the characteristics, operation, and selection of reciprocating, rotary, and centrifugal pumps. Definitions, basic formulas, examples, and various pump data are included.

Circle **Item 21** on Inquiry Card



Baseboard Diffusers

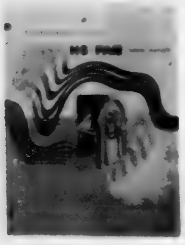
Bulletin BP-61, published by The Auer Register Co., Cleveland, Ohio, describes the 300-S Series of baseboard diffusers, designed for the large volumes of air required in public and commercial buildings. Covers design features, specifications, and performance data.

Circle **Item 16** on Inquiry Card

Heavy-Duty Air Cleaners

Heavy-duty electronic air cleaners are described in Catalog 1435 offered by Westinghouse Electric Corp., Boston, Mass. Sections of booklet are devoted to construction features, principles of air cleaning, selection data, and details on specific applications.

Circle **Item 22** on Inquiry Card



Fans

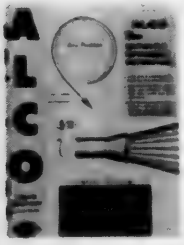
American - Standard Industrial Div., Detroit, Mich., announces a new 44-page catalog, Bulletin A-1203, describing its line of HS Fans. Construction features, drive arrangements, and fan components are discussed and capacity tables for all sizes are listed.

Circle **Item 17** on Inquiry Card

Off-the-Floor Closet Carriers

Josam Mfg. Co., Michigan City, Ind., announces 4-page Manual FR-3, which describes a complete line of Rezitron residential carriers for installation of off-the-floor bathroom fixtures. Manual explains features, lists the many types of carriers, and gives detail drawings.

Circle **Item 23** on Inquiry Card



Refrigerant Distributor

The Venturi-Flo refrigerant distributor, said to provide maximum distribution efficiency with a minimum pressure drop, is described in 32-page Bulletin 188-61, published by Alco Valve Co., St. Louis, Mo. Capacities for various evaporator temperatures are given.

Circle **Item 18** on Inquiry Card

Heating and Ventilating

A 32-page catalog for large heating and ventilating units and heat diffusers is available from Carrier Air Conditioning Co., Syracuse, N. Y. Catalog contains selection charts for steam and hot water coil capacities, fan motor ratings, and dimensional data for all models.

Circle **Item 24** on Inquiry Card

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Electronic Air Cleaner

A high velocity electrostatic precipitator for use with air handling units is described in 16-page Bulletin 258B, published by American Air Filter Co., Inc., Louisville, Ky. Includes electronic principle, design features, capacities, dimensions, and maintenance.

Circle **Item 25** on Inquiry Card

Need for Make-Up Air

"Design Considerations for Make-Up Air Systems," an 8-page handbook, is the first in a series to be published by Reznor Mfg. Co., Mercer, Pa. Handbook points up need for tempered make-up air to replace room air expelled by fans or forced air exhaust.

Circle **Item 26** on Inqniry Card

Surge Arrestor Valve

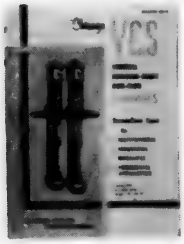
A 16-page bulletin, W-16, describes the Cushioned Surge Arrestor valve, a product of Golden-Anderson Valve Specialty Co., Pittsburgh, Pa. Complete technical details and drawings are listed including control arrangements, installation, specifications, and settings.

Circle **Item 27** on Inquiry Card

Air Moving Equipment

Roof ventilators, unit heaters, and wall and centrifugal fans are discussed in 10-page Bulletin DB7-102 made available by Ilg Electric Ventilating Co., Chicago, Ill. The bulletin includes performance data, design features, and dimensions for all equipment.

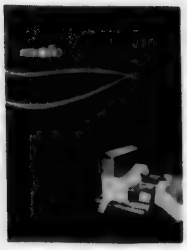
Circle **Item 28** on Inquiry Card



Sewage Pumps

Pumps for sewage and drainage problems are the subject of an 18-page bulletin published by Chicago Pump - Hydrodynamics Div., Chicago, Ill. Includes selection tables and their use; how to determine pump capacities; basin and cover selection; and construction details.

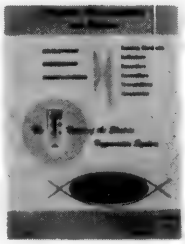
Circle **Item 29** on Inquiry Card



Gas-Fired Make-Up Air Units

Six basic types of direct gas-fired make up air units are described in a 16-page catalog, Bulletin C-101, published by Metals Engineering & Mfg. Co., Detroit, Michigan. Also shown are 9 models of burner sections and make-up air system accessories.

Circle **Item 30** on Inquiry Card



Humidity Instrumentation

An 8-page catalog, SF-1, published by Hygrodynamics, Inc., Silver Spring, Md., lists complete line of hygrometer instrumentation and systems for industrial applications. Catalog describes sensing elements, indicators, recorders, controllers, and accessories.

Circle **Item 31** on Inquiry Card

Shower/Bath Control

Leonard Valve Co., Cranston, R. I., describes its newest shower/bath control, the Showermaster, in a 4-page folder. Listed are features of the two available models, which are designed for use in residences, hospitals, schools, dorms, hotels, and similar installations.

Circle **Item 32** on Inquiry Card

Air Conditioning Units

The Ready Power Co., Detroit, Mich., announces a bulletin describing its line of natural gas air conditioning units and matched chiller packages. Information on design features, specifications, control systems, applications, and cost studies is included.

Circle **Item 33** on Inquiry Card

Slot-Type Diffusers

An 18-page manual describing the features of extruded aluminum slot-type diffusers is available from Air Devices, Inc., New York, N. Y. Manual covers applications, diffuser cores, frame styles, performance charts, and methods of testing diffusers.

Circle **Item 34** on Inquiry Card

Steam Coils

Type 5 steam coils are the subject of 32-page Catalog 305 issued by McQuay, Inc., Minneapolis, Minn. Information on specifications, coil selection and performance, and piping data is discussed. Charts, tables, diagrams, example problems, and solutions are included.

Circle **Item 35** on Inquiry Card

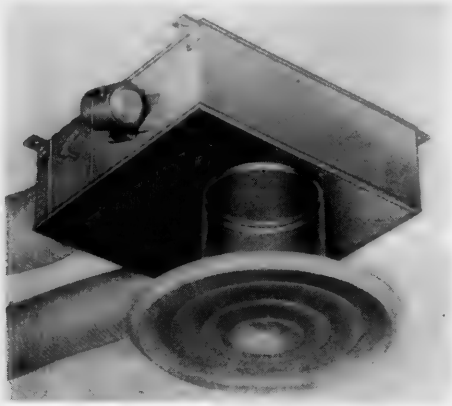
Pocket Engineering Guide

A pocket reference engineering guide is announced by Carrier Air Conditioning Co., Syracuse, N. Y. Guide contains psychrometric charts, refrigerant weights, volumes, enthalpy, pipe sizes, heating and cooling operating costs. Available upon request from Carrier offices in principal cities.

Use the convenient prepaid yellow postcard in the back of the magazine for securing more information about new equipment and materials described in this department.

Low-Velocity Dual-Duct

Completely packaged, the low-velocity dual-duct ATC unit has been specifically designed for low-velocity, and is claimed to offer a number of important, money-saving features for the engineer who recognizes the advantages of individual room control inherent in dual-duct air distribution systems.



Carnes Corp., Verona, Wis., first to offer this type of unit, tells of other features, such as "pinpoint" temperature control for specific rooms, perfect blending of the hot and cold air for discharge to individual space areas, attenuation of self-generated as well as duct-carried noise, manual volume adjustment and choice of operation by either pneumatic or electric temperature controls.

The company offers two ceiling models—bottom and end discharge, in 5 sizes—and two window/perimeter models—top and front discharge, in 2 sizes.

More Information? Circle Item 36 on Inquiry Card.

Compact Sewage Treatment Plants

A series of compact sewage treatment plants is offered by Dorr-Oliver Inc., Stamford, Conn., in a range of six sizes for effective, low-cost waste treatment for housing developments, garden apartments, shopping centers and recreational facilities. With these designs, mechanical purification processes are able to provide the modern alternative to old fashioned septic tanks and sub-surface disposal fields.

These compact sewage treatment plants utilize the Biofiltration process, proved in many municipal installations throughout the world. The degree of treatment provided, including chlorination, permits safe disposal of the effluent in a nearby water course or body of water. Design criteria meet all requirements of local, state and national regulatory agencies. Features inherent in the Biofiltration process, such as the high recirculation rate and separate sludge digestion and storage, permit these plants to handle varying flows and varying strengths of sewage automatically, without constant attention and adjustments.

Standard designs, based on a 24-hour run-off, cover a range of 10,000 to 180,000 gallons per day. State board of health regulations determine per capita requirements.

More Information? Circle Item 37 on Inquiry Card.

Preheater Eliminates Freezeup

A steam or hot-water preheater section for air conditioning systems, designed by L. J. Wing Mfg. Co., Linden, N. J., offers close temperature control, virtually no stratification, and maximum protection against freezeup. Tubes are individually and readily replaceable. The unit can be used as a heater in fresh-air-supply and other systems with no preheat unit.

The section uses a face and bypass damper system for temperature control. Steam pressure or hot water flow remains constant regardless of inlet air temperature variations, eliminating the trapping problems and danger of freezeup associated with temperature control by throttling of the heating medium.

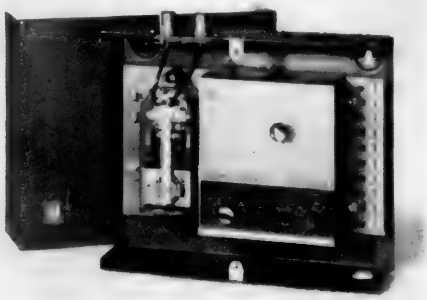
Available in 11 sizes for installation in ducts from 3 sq ft to 48 sq ft in cross-sectional area, the sections may be installed singly or in multiple arrangements to fit most size ducts. Minimum steam pressure is 5 psig; maximum is 200 psig with standard construction. Optional materials are available for higher pressures and temperatures or unusual atmospheres.

More Information? Circle Item 38 on Inquiry Card.

Transistorized Transducer

A transducer to electronically convert temperature into air pressure is announced by Commercial Div., Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. The transducer, called the Mark III, has transistorized circuitry and etched circuit boards.

A transducer is the link between electronic sensing and pneumatic operation, which is said to permit air conditioning control systems to use the best features of each. With the transducer, the sensitivity, flexibility and fast response of electronic thermostats can be combined with the smoothness and power of pneumatic operation, the firm states. In effect, the electronic system becomes the sensitive "nerves" of a



control system while the pneumatic system provides the "muscle."

The Mark III transducer can take inputs from up to three different thermostats. Outputs can be sent to pneumatic motors, dampers and valves. The transducer also can link a pneumatic system to a centralized electronic control center to permit operation of an entire building from one remote location.

More Information? Circle Item 39 on Inquiry Card.

Gas Water Heaters

Designed to meet the 180 deg F sanitizing rinse water requirements of Standard No. 5 of the National Sanitation Foundation, a line of Ruud Copper Sanimaster commercial gas water heaters has been introduced by Ruud Manufacturing Co., Kalamazoo, Mich.

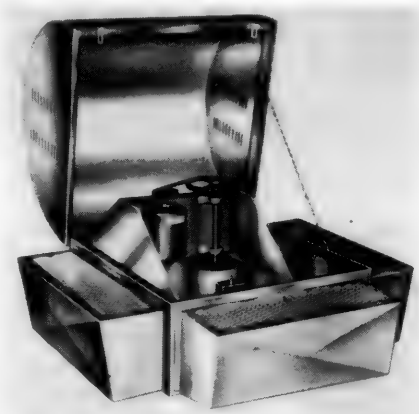
Each model or combination is specifically approved for one or more of the six door and conveyor-type dishwashing machine classifications of Standard No. 5. Five models are equipped with the Ruud duo-temp proportioning device for the delivery of two hot water temperatures simultaneously; at 180 deg and at any general-purpose degree from 100 deg to 160 deg. If only general-purpose, kitchen-use hot water is needed, water can be heated to 180 deg and mixed with cold water in the duo-temp fixture to deliver a single, selected temperature from 100 deg to 160 deg. The hot water capacity of the tank is thus effectively increased by as much as thirty per cent.

Other advantages include small required floor space; design which permits another Sanimaster unit to be added to meet increased demands without high change-over cost; point-of-use installations for operating economy. All units are of external flue design which makes the tank stronger and facilitates the removal of lime and other deposits from inside the tank.

More Information? Circle Item 40 on Inquiry Card.

Exhauster Moves Gases Quickly

A roof exhauster designed to throw fumes, odors, and gases high into the air has been developed by Penn Ventilator Co., Inc., Philadelphia, Pa. It is designed for applications involving hot, dirty, steam-laden and greasy or explosive gases that must be



quickly removed and dissipated without harming the fan itself.

The exhauster features weather-proof construction, which is self-contained, fully housed, and installed out of the way on the roof. It is recommended for air-removal problems that require a quiet steady exhaust.

More Information? Circle Item 41 on Inquiry Card.

Resin Protects Underground Piping

Ric-wiL, Inc., Barberton, Ohio, manufacturer of underground prefabricated piping systems, announces a field closure material called Rip-Coat, a mastic colloidial resin that is highly resistant to moisture, weathering, acids, alkalies, and electrolysis. It is unaffected by temperatures ranging from sub-zero to 250 deg F. The coating can withstand severe distortion and bending.

In the field, Rip-Coat is brushed on over the welded conduit joint and then a glass-wrap material is applied over it (see illustration). A final coating is then applied over the wrap material to complete the closure.

More Information? Circle Item 42 on Inquiry Card.

Insulating Cement Introduced

A high temperature insulating cement with an increased effective temperature range to 2100 deg F is now offered by Baldwin-Ehret-Hill, Inc., Trenton, N. J. The material is called BEH No. 1 Plus insulating cement.

In addition to withstanding higher temperatures, the cement is whiter than the 1800 deg cements which it replaces and is easier to handle. Through a reduction in nodule size of the mineral wool, the mixed material, ready for application, is less lumpy. Greater smoothness and uniformity are characteristic of the new material. Actual tests indicate dry coverage of 45 sq ft 1 inch thick per 100 lb. The linear shrinkage after heating to 2100 deg is 3%. No change in methods or thickness of application is required.

More Information? Circle Item 43 on Inquiry Card.

3 in 1 Drawing Aid Introduced

A plastic 12-inch combination triangle, T square, and parallel ruler is now being marketed by Rol-Ruler Co., Riegelsville, Pa. The ruler can draw vertical, horizontal, and parallel angular lines in automatically measured distances.

A built-in roller allows smooth easy movement up or down when drawing lines. An index window automatically indicates distances between lines, angular and horizontal (as close as $\frac{1}{16}$ inch). Lines can be spaced the same or varied distances apart. Circles and arcs can be drawn up to a diameter of 22 inches.

More Information? Circle Item 44 on Inquiry Card.

Correction: In connection with their article, "Air Conditioning Laboratory Animal Quarters" in the July issue, photographs of the authors were inadvertently transposed on page 72. They are shown correctly below:

CROSSMAN

Robert F. Crossman, manager of export unit engineering of Carrier Air Conditioning Co., a division of Carrier Corp., is a graduate of Syracuse University with a B.S. in mechanical engineering. He joined Carrier in 1951 as an application engineer in the Syracuse home office, became a senior engineering instructor in 1954, then moved on to unitary equipment engineering. In 1958 he was named to his present post. He is a member of ASHRAE and a professional engineer, registered in New York. He is the author of several articles on air conditioning.

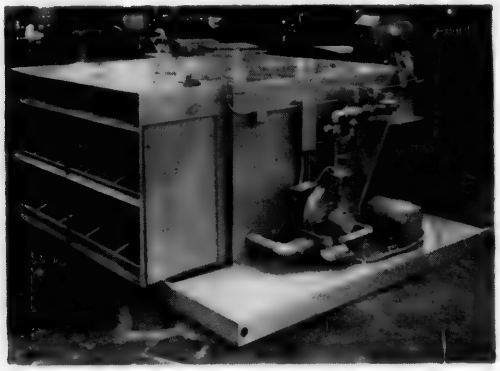
Ralph Elsea, senior application engineer for Carrier Air Conditioning Co., joined the company in 1945 upon his discharge from the Air Force. His first assignments were as draftsman and branch engineer in the St. Louis office. In 1951 he became a project engineer in the Chicago office. He was assigned to the Syracuse home office in 1953 as an application engineer with major responsibilities in system design. He was named to his present post in November, 1960. He is a graduate of the Missouri School of Mines and Metallurgy, with a B.S. in mechanical engineering.

ELSEA

Industrial Space Heaters

A new line of industrial forced air space heaters, designed for use in buildings where frequent air changes are necessary, is being manufactured by Dravo Corp., Pittsburgh, Pa.

Called the Directflow heater, the gas-fired unit is particularly suited to industrial plants where noxious gases, acid fumes, dust or hot vapors are released as part of the manufacturing processes and expelled by exhaust fans. It can be equipped for either indoor or outdoor installation.



Unlike some heaters, in which combustion takes place in a combustion chamber, the Directflow has no combustion chamber and handles only non-recirculating makeup air. Combustion occurs in the air stream, with resultant gases emitted into the plant with heated outside air.

The unit is available in seven models, ranging in air output capacity from 11,000 cfm to 60,000 cfm and in heat output up to 6,750,000 Btu per hr, with a maximum turndown ratio of 25 to 1.

More Information? Circle Item 45 on Inquiry Card.

Brass Coupling For Plastic Tubing

Fast, easy, pressure-tight coupling of plastic tubing without the use of special tools is possible with a new line of brass fittings developed by Spanco Brass Co., Otsego, Mich.

Both low pressure and high pressure couplings are available, in three sizes, for polyethylene and similar plastic tubing. Tubing sizes accommodated include 1/4 inch OD with .040 inch wall; 5/16 inch OD with .062 inch wall; and 3/8 inch OD with .062 inch wall. Temperature rating is to 140 deg F., and recommended working pressures for this tubing are 136, 169, and 141 psi respectively for the three sizes.

Fittings have a smooth inner sleeve over which the plastic tubing is pushed to a stop. Tightening a nut applies clamping pressure against inner and outer tubing walls, to hold it firmly and prevent both leakage and slipping.

More Information? Circle Item 46 on Inquiry Card.

Instrument Controls Humidity

Phys-Chemical Research Corp., New York, N. Y., announces Hygrocon-1, a composite humidity reader and humidify/dehumidify controller, incorporating the PCRC Electro-Humidity transducer as its sensing element.

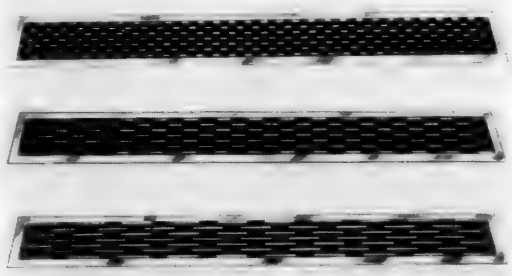
The Hygrocon permits complete control of the relative humidity in any given enclosure to within a fraction of 1% r.h., throughout the entire relative humidity range at temperatures as high as 180 deg F.

The transducer, connected by cable to the Hygrocon, samples the atmosphere within a given enclosure (multiple sensing blocks are an available accessory). A function selector dial determines the mode of operation. Humidity can be read directly in % r.h. on a four-inch panel meter. Power output is 1-hp with 10-hp contactors available.

More Information? Circle Item 47 on Inquiry Card.

Linear Air Diffusers

Extruded aluminum linear air diffusers, called the Titus Staccato line, is announced by Titus Manufacturing Corp., Waterloo, Iowa. This line, according to the company, introduces an exclusive new dimension to the linear concept of continuous line diffusers, and opens up new architectural design possibilities.



To get the "staccato" effect, the louvers of the diffusers have been recessed at regular intervals, with the intervals being varied according to design desired. This has made it possible to highlight a series of short-spaced "dashes" along each louver that stand out in relief against a dark background. The face of the raised sections on each louver are in brushed satin aluminum finish and present a striking contrast to the anodized black finish of the rest of the louver.

Diffusers can be used in the sidewall or ceiling, and are available in 2 basic types: Standard Staccato with 7/32 x ¾-inch louvers spaced in ½-inch centers; and Fineline Staccato with ⅛ x ¾-inch louvers spaced on ¼-inch centers.

More Information? Circle Item 48 on Inquiry Card.

Ceiling Diffuser Dampers

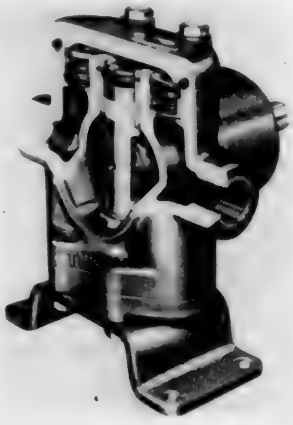
Air Control Products, Inc., Coopersville, Mich., announces a changeover from cold-rolled to galvanized steel in the construction of its line of ceiling diffuser dampers and installation rings, giving improved resistance to rust and corrosion. Despite the higher cost of galvanized steel, prices will remain unchanged.

The absence of paint around the operator mechanism insures a smooth opening and closing action. Dampers are operated by a screw-type nylon rack and pinion mechanism. Backlash tolerances in the mechanism are close to zero in order to prevent blade flutter under high velocities. An adjustable stop on the damper makes it easy to balance the system at the diffuser face, the firm reports.

More Information? Circle Item 49 on Inquiry Card.

Motor Driven Piston Pump

A direct motor driven piston pump that will operate at pressures up to 500 lb is announced by Hypro Engineering, Inc., Minneapolis, Minn. The compactly designed 2-cylinder piston pump handles a wide variety of solutions and suspension - type chemicals. Weighing only 9 lb, the pump, called the Hypro Small-Twin Model 5300, is offered in two sizes: 2 gpm and 3 gpm—at the maximum speed of 1800 rpm.



Typical uses include high pressure washing of cars, trucks, buildings and equipment; boiler feed, hydrostatic testing, atomizing liquids, metering, pressure boosting, steam cleaning; spraying protective coatings, insecticides, and other chemicals.

Specifications include a cast-iron body with stainless steel valves, Ni-Resist cylinder sleeves, and plastic-impregnated leather piston cups. Specially-compounded rubber and teflon filled fabric cups are also available. Ports are tapped ½-inch npt; stainless steel shaft is ⅝-inch diameter with keyway. Two heavy-duty sealed ball bearings support the stainless steel drive shaft.

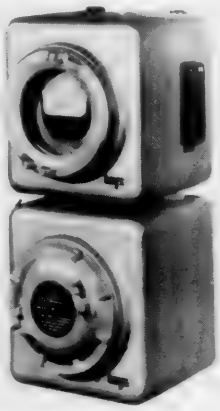
Larger volume model, designated Hypro Big-Twin piston pumps, operate at speeds to 600 rpm with output of 10 gpm and 6 gpm. Weight of Big-Twin pumps is 15 lb; ports are ¾-inch npt.

More Information? Circle Item 50 on Inquiry Card.

Paramagnetic Oxygen Analyzer

An explosion-proof low range oxygen analyzer for gas mixtures has been introduced by The Hays Corp., Michigan City, Ind.

Dual range design (0-1 or 0-2 and 0.5%; 0-1, 0-2, or 0-3 and 0-10%) permits tracking while process is brought into range and provides precision analysis (±2%) under normal operation. New Model 632C is



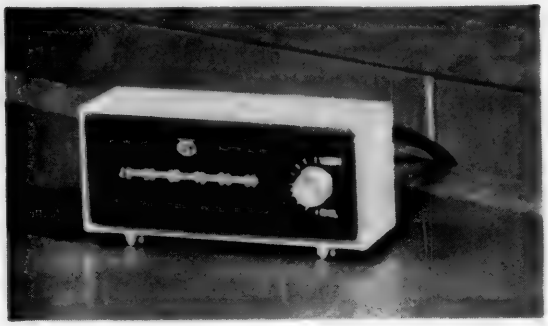
not affected by the presence of hydrogen or other hydrocarbons in the background gas. Featuring a built-in indicator, it requires no external receiver. However, most any d-c receiver meeting certain specifications may be used.

The analyzer applies a new concept of the principle involving oxygen attraction by a magnetic field (paramagetism). Recording the variations in paramagnetism of a sample mixture of gas at a constant temperature, provides a continuous, accurate record of oxygen content of the gas. When coupled with a suitable sampling system, the low range oxygen analyzer provides extremely fast response (time constant: 4-7 seconds) to fluctuations in oxygen content.

More Information? Circle Item 51 on Inquiry Card.

Temperature Controlled from Desk

It is now possible for a person to dial his or her own comfort by reaching to a desk thermostat located within arm's length, according to its manufacturer, The Powers Regulator Co., Skokie, Ill. The thermostat is suited for executive offices and conference rooms where it is important that temperature adjustment be both precise and handy in accommodating one or a few individuals or a large staff meeting.

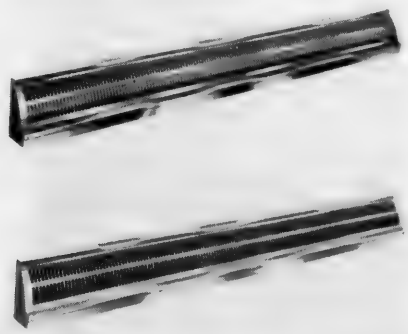


The instrument takes no more desk space than a conventional desk clock, yet is heavy enough to prevent accidental brushing or tipping. It is pneumatically operated and adaptable to most space temperature control application.

More Information? Circle Item 52 on Inquiry Card.

Diffusers Allow Greater Free Area

Availability of two new baseboard diffusers, each of which provides at least 25% more free area than existing, comparably sized models, is announced by Auer Register Co., Cleveland, Ohio.



The new "300" Series two and four-foot baseboard diffusers offer low resistance and maximum throw and spread, and in appearance and design match their respective base intakes. The units are available for perimeter installations of any desired capacity for heating or combination heating and cooling systems.

More Information? Circle Item 53 on Inquiry Card.

Hot Water Filter Introduced

The Cuno Engineering Corp., Meriden, Conn., has developed a hot water filter and hot water filter cartridge which, when installed after the hot water tank, filters out rust, iron, scale, algae, silt, and other suspended matter.

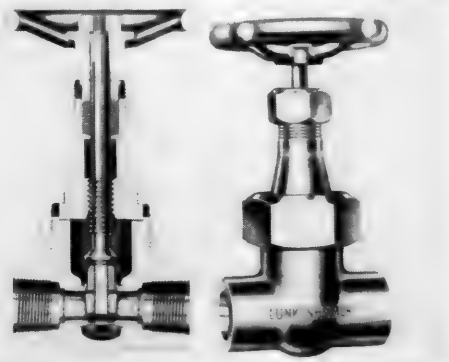
The filter sump, made of stainless steel with a brass head, is designed for hot water systems with temperatures ranging from 100 deg F to 210 deg. A hot water filter cartridge is included in the ready-to-install package. Typical applications are homes, hotels, laundromats, hospitals, restaurants, and most applications where clean, clear hot water is essential. The filter, designated No. P12, can be installed on any ¾ inch pipe and uses Cuno's disposable hot water filter cartridge P112.

More Information? Circle Item 54 on Inquiry Card.

Steel Gate Valve

An inside-screw small steel gate valve, newly designed and compactly made for fast installation in a limited space, is introduced by Lunkenheimer Co., Cincinnati, Ohio.

This gate valve has screwed or socket ends, available in a bolted bonnet design in 1½ and 2-inch sizes, and in a union bonnet (illustrated) in sizes ¼ through 1 inch. An inside-screw rising stem, solid-wedge disc, and rolled-in seat rings are features of the valve. Valves are rated 800 lb at 850 deg F, and



2000 lb at 100 deg. This valve line will be a companion to the line of 800 lb forged steel gate valves, with outside-screw rising stem.

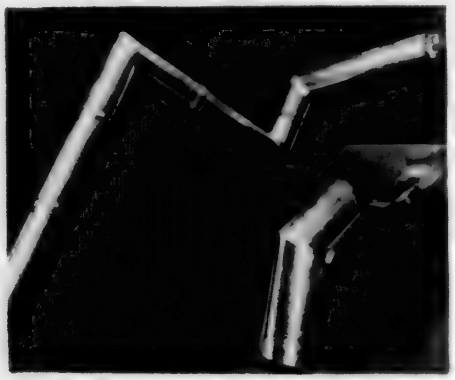
An accurately-machined solid-wedge disc is guided to a firm, tight seat, without dragging across the seat rings. Discs are 13 chrome stainless steel, heat treated completely through to eliminate chipping or cracking. Rolled-in 13 chrome stainless steel seat rings never loosen in service and prevent leakage.

More Information? Circle Item 55 on Inquiry Card.

Jacketed Pipe Insulation

A technique in applying jacketed pipe insulation allows job-site fabrication of aluminum-covered elbows, turns, sweeps, and bends directly from straight lengths. Developed by Johns-Manville, New York, N. Y., for use with its Metal-On system, the time and money-saving method is made possible by a pre-formed band, called the Miter-Seal.

Use of Miter-Seals for angle insulation eliminates the many complex operations previously necessary for insulating fittings and bends, as well as stocking and storage problems with pre-formed humped elbows and fitting covers.



J-M Metal-On is a pre-jacketed insulation system that consists of Thermobestos, an isolation barrier, and a weatherproof aluminum covering, all prefabricated for application in one step, by snapping the 3-ft sections over the pipe and securing with an aluminum snap-strap, provided. Metal-On is available for pipe from ¾ inch up to 24 inches, with insulation from 1 inch to 3 inches thick.

More Information? Circle Item 56 on Inquiry Card.

500-Watt Pool Lamp

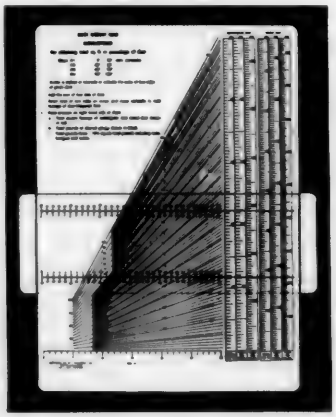
A 12-volt 500-watt lamp for underwater use in swimming pools, fountains, and elsewhere is announced by General Electric Co., Cleveland, Ohio.

Eight inches in diameter, the lamp resembles a sealed-beam auto headlamp. It throws a wide and powerful beam of light under the water (about 60 degrees horizontally and 30 degrees vertically) and has a peak beam candlepower of about 20,000.

More Information? Circle Item 57 on Inquiry Card.

Scale Reduces Duct Calculations

Carl Raymond & Co., Los Angeles, Calif., introduces its Duct Weight Rule, which simplifies calculations of square footage and poundage of ducts to ASHRAE metal gage standards.



The rule consists of four scales printed on vinyl plastic, laminated with a clear plastic coating. Its overall dimensions are 8x11 inches and can be used on duct sizes 0 to 120 inch semi-perimeter and lengths 1 to 100 ft.

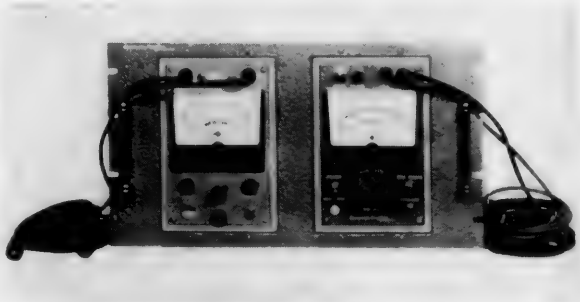
Also included on the rule is a galvanized-aluminum comparison chart, size of angle iron weights, and taping and insulation formulas.

More Information? Circle Item 58 on Inquiry Card.

Insulation Leakage Measured

Both high voltage breakdown tests and insulation leakage measurements can be made with the Model 8527 Test Set developed by Associated Research, Inc., Chicago, Ill.

The Hypot section of the instrument provides a-c potential that is continuously variable from zero to 1.5 kv for breakdown testing, with separate read-out lights to indicate breakdown and leakage current above a preset value. Other models are available with higher a-c test potentials or with d-c test potentials.

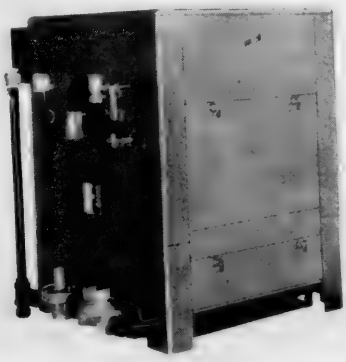


The Vibrotest megohmmeter section measures insulation resistance to 50,000 megohms. Models are available for measuring insulation resistance to five million megohms.

More Information? Circle Item 59 on Inquiry Card.

Gas Boiler Introduced

Burnham Corp., Irvington, N. Y., has introduced a large-size gas boiler, the Holiday 80, for apartments, schools, office buildings, motels, and commercial and industrial buildings. The boiler is produced in twenty-nine sizes, from 2,880 to 23,850 sq ft water rated, and from 1,800 to 14,913 sq ft steam I-B-R rated, and is A.G.A. approved for all gases. Inputs



vary between 720,000 and 5,760,000 Btu per hr.

The boiler is made of corrosion-resistant cast-iron and its sections are so compact they can be moved easily through an ordinary door opening. Burners are ribbon-type, high capacity herringbone design in stainless steel, and no spacers are required. The base is of steel construction and provides support for the cast-iron sections. All the boiler sections are tested for 50 lb of working pressure. Sections tested for 80 lb of working pressure are available on order.

Built-in tankless or storage hot water heaters, all-copper construction, are available, to be installed at the top nipple ports where water is hottest in both steam and water boilers. Top tappings assure drier steam and easier header construction.

More Information? Circle Item 60 on Inquiry Card.

Color-Coded Furnace Filter

A hexachlorophene-treated, color-coded, glass fiber furnace filter has been introduced by American Air Filter Co., Inc., Louisville, Ky. The filter contains many new features and is better than previous filters, according to the manufacturer.

The filter is treated with hexachlorophene to help fight bacteria. The filtering media, which is spun with progressing density from one side to the other, provides better dirt-catching efficiency per square inch than was previously attained. By color-coding the different sizes, the customer no longer has to remember the size filter he needs for his furnace, but merely the color of the label.

More Information? Circle Item 61 on Inquiry Card.

Heat Exchanger Has O-Ring Seals

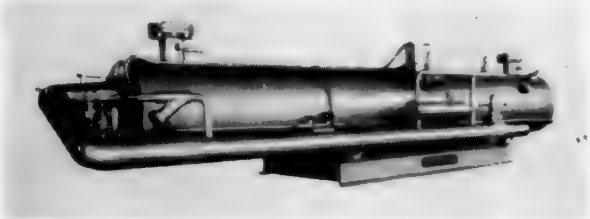
Basco, Inc., North Tonawanda, N. Y., announces a new line of heat exchangers featuring O-ring seals, which permit the tube bundle to expand and contract without harmful strain or intermixing of shell and tubeside fluids. The O-rings retain compression without adjustment and are unaffected by vibration or temperature changes.

These removable tube bundle Type OP heat exchangers are available with shell diameters of 6 through 16 inches. They are suitable for many applications including oil or water cooling of internal combustion engines, compressors, steam and gas turbines, reduction gears, and electrolyte cooling for liquid rheostats.

More Information? Circle Item 62 on Inquiry Card.

Packaged Chiller Unit

This packaged 100-ton chiller unit is engineered by The Ready-Power Co., Detroit, Mich., for use with its natural gas compressor or condensing unit. A complete refrigeration unit, it includes a drier, pilot-operated thermo-expansion valve, solenoid controlled compressor oil return circuit and sight glasses.



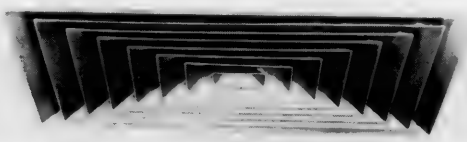
The chiller package includes control thermostat freeze-up switch, and interlock connections for a flow switch or chilled water pump.

Dehydrated before shipment with a holding charge, each chiller is load tested at full flow water rates with the compressor or condenser unit with which it will be used. Matching water chillers are available on air cooled condensing applications as well as water cooled, and may be obtained with single or dual refrigeration circuits from 25 to 300 tons.

More Information? Circle Item 63 on Inquiry Card.

Aluminum Directional Diffuser

An all-extruded aluminum directional diffuser is announced by Waterloo Register Co., Inc., Waterloo, Iowa. This long-lasting Type D diffuser is easy to install and one-third the usual weight because of aluminum construction. It is available in five frame styles and fourteen core patterns. All cores are removable and interchangeable.

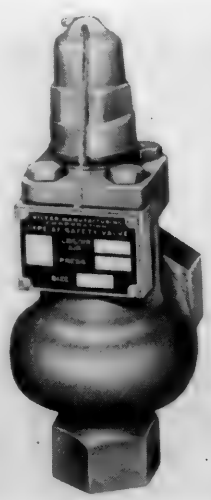


Square and rectangular designs include one-way flow, two-way opposite flow, three-way flow, and two-way corner flow. The diffuser comes with snap-in, bevelled, drop collar, flange, and lay-on frames.

More Information? Circle Item 64 on Inquiry Card.

Safety Valve Introduced

A wide-range capacity safety valve with capacity to adequately protect most applications encountered in the average refrigeration installation has been announced by Vilter Mfg. Corp., Milwaukee, Wis. Tests have shown that this ½-inch valve with 1-inch outlet has a gas-handling capacity greater than earlier supplied valves.



The valve body has a pear-shaped contour which provides the ample gas-flow space necessary to achieve its large capacity. It is designed so that the gas escaping at high speed passes horizontally over the valve seat when the valve pops. This sweeps the surface clean so that it is almost impossible for dirt to lodge in this vital area and enables the valve to seat tight again after it has popped.

Valve is suitable for both ammonia and halocarbon service. It has a capacity range of from 1895 lb of air per hour at a set pressure of 100 psig through 7790 lb per hour at 425 psig.

More Information? Circle Item 65 on Inquiry Card.

Thermistor/Thermocouple System

The A+ 540 thermistor/thermocouple system, called a highly accurate, low-cost means of combining continuous process temperature control at various locations with indication at a central point, is anounced by Atkins Technical Inc., Cleveland, Ohio.

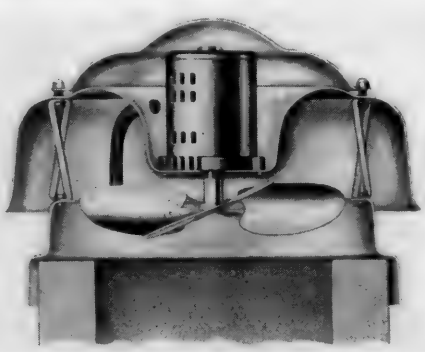
System combines the inherent advantages of either transducer: Thermistors are extremely sensitive to temperature change and do not require expensive circuitry; thermocouples are very stable over extended periods of temperature measurement. Performance of the combination is better than that of either type alone, and at substantial savings.

The A+ 540 system consists of three main elements: Probes, thermistor controls, and potentiometric indicator. Reliability of the system is reported to be unsually high because the thermistor circuits and the thermocouple circuits operate independently and double check each other. The new systems will be widely used with alarm action as well as on/off and other control options. For example, bearing temperatures can be monitored continuously at numerous points with control read-out, all at modest cost.

More Information? Circle Item 66 on Inquiry Card.

Axial Blade Ventilator

Swartwout Fabricators, Inc., Kokomo, Ind., is now marketing an axial blade ventilator with fiberglass housing. Called Swartwout Axial Fiber-Aire, the ventilator comes in nine units with capacities from 1220 to 4580 cfm at 0-inch static pressure.



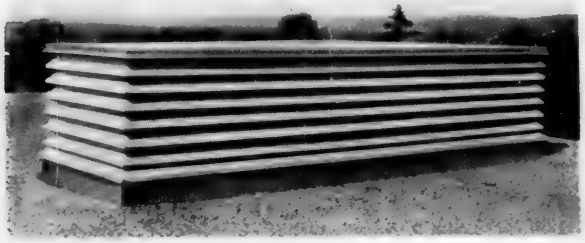
The vibration-absorbing ability of fiberglass, plus the use of stainless steel air flow guides, reduces noise and vibration to a low level. Elements such as weather, chemical abuse, fumes, and fire, which would ruin most metal housings, leave the fiberglass housing unharmed, the firm reports.

More Information? Circle Item 67 on Inquiry Card.

Roof Ventilation Penthouse

Construction Specialties, Inc., Cranford, N. J., introduces a pre-fabricated extruded aluminum penthouse for use as an air intake or air exhaust unit in handling ventilation problems through the roof.

Louver blades extend continuously around all four sides. Corners are mitered and welded. Blades and sill are made of extruded aluminum sections of 6063-T5 alloy, minimum .081 gauge. All fastenings are stainless steel. All roofs are designed for a minimum 30 lb snow load with proper safety factor. Roofs are removable for access.

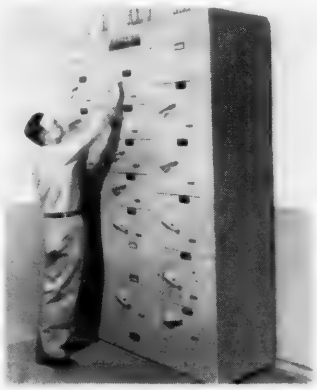


Where air control is desired, operating louvers can be supplied in place of the standard fixed blades. Air control may also be obtained by automatic dampers secured at the rear of fixed blades, or by the use of a dual combination louver. This consists of any combination of fixed louver, either standard or stormproof, with any C-S adjustable louver assembled at rear of fixed louver.

More Information? Circle Item 68 on Inquiry Card.

Motor Control Center

A motor control center introduced by Allis-Chalmers Mfg. Co., Milwaukee, Wis., provides a compact assembly of all electrical components needed to serve an air conditioning system.



Units can be added to these centers to provide for changes in control requirements. Plug-in terminal blocks permit fast unit interchange and easy horizontal drawout for inspection and maintenance. The centers are effective where six or more starters and associated equipment are required. They can be used to regulate most types of low-voltage load including lighting and heating, motors, pumps, compressors, and fans.

More Information? Circle Item 70 on Inquiry Card.

Multi-Fintube Heat Exchanger

A heat exchanger has been developed by the research laboratory of Brown Fintube Co., Elyria, Ohio, incorporating a bundle of fintubes into a high pressure, hairpin-type shell. The exchanger is suited for high pressure operations up to 6000 psig in the tubes and 1800 psig in the shells.

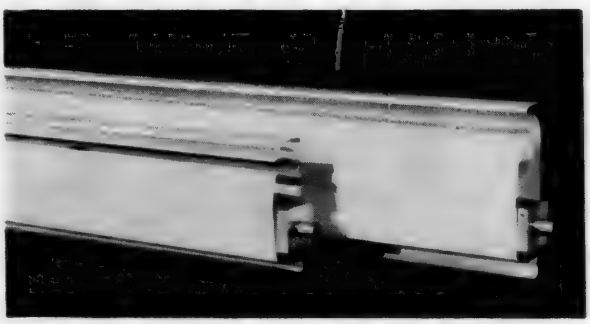
The advantages of using a bundle of fintubes over the conventional single tube in a double pipe exchanger is that it increases capacity permitting a reduction in the cost of sizing many jobs, the company explains. One multi-fintube unit with its higher heat transfer capacity can replace as many as four conventional units, according to the manufacturer.

The heat exchangers are made in 4-inch shell size and are also available with bare tubes for services which require no fins. They have the advantages of standardization associated with double pipe sections as the proper quantity of the same identical unit may be used in banks to meet any given duty.

More Information? Circle Item 69 on Inquiry Card.

Heater Suited For Limited Area

A baseboard panel developed by American Standard Plumbing & Heating Div., New York, N. Y., is suited for installations where baseboard areas are limited, or where more than average heating capacity is required.



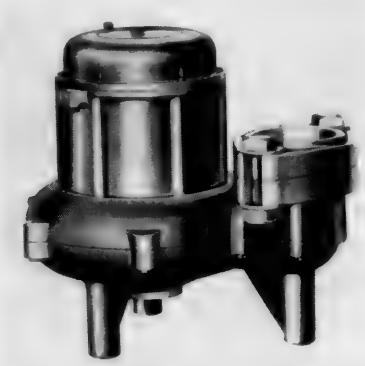
The heater has two, quick-response heating elements for meeting various heat requirements. Other features include a combination splitter/damper, which can be set at any interval from open to closed, built-in tube supports which eliminate use of wire hangers for connecting tubes, and five panel lengths (3, 4, 5, 6, and 8 ft) to accommodate most installations.

More Information? Circle Item 71 on Inquiry Card.

Ejector Pump

The Piqua Machine and Mfg. Co., Piqua, Ohio, is offering an ejector pump that will handle jobs such as sewage ejection, transformer vault and manhole drainage, processing waste and highway underpass drainage.

The pump has a non-clogging impeller that will discharge liquids, semi-solids and solids from packing plants, cannaries and other operations where stringy wastes and bulk solids result.

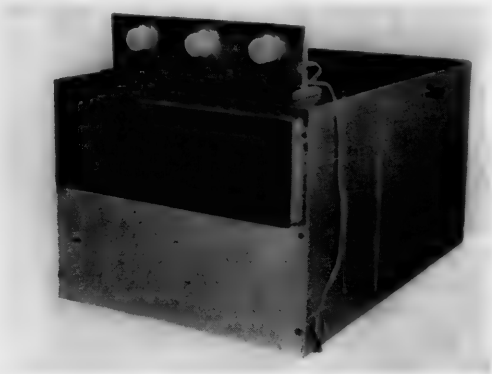


According to the manufacturer, the pump has a ½-hp rating and a discharge of either 2 or 3 inches. The 2-inch model has a capacity of 4500 gph at 10 ft head, and the 3-inch model has a capacity of 5880 gph at 10 ft head.

More Information? Circle Item 72 on Inquiry Card.

Furnace Provides Zoned Heat

An electric furnace, which provides heat for residential and commercial structures, is produced by Electro Zone Co., Milwaukee, Wis.



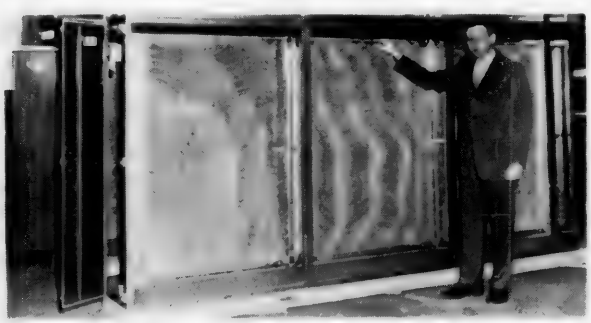
The furnace comprises a heat exchanger having twelve passes, each of which contains two electric heating elements. A low voltage control system enables the installer to select the proper number of electric elements to provide the correct amount of heat for each zone. The heating elements are controlled by a thermostat in each of the selected zones.

Each of the twelve passes of the 24 x 8-inch outlet is 2 inches wide to accommodate standard duct work, which is available in increments of 2-inch widths. This flexibility makes it possible to match the capacity of the furnace to the heat loss of the structure. For example, a zone which was connected to 3 passes of the furnace could be heated by four, five, or all six of the heating elements according to the heating requirements of that zone.

More Information? Circle Item 73 on Inquiry Card.

Dirt, Dust, and Odor Control System

CRS Industries, Philadelphia, Pa., announces its new custom screen units and screen assemblies, which, along with generators, form the operating components of the Statronic, an electronic dirt, dust, and odor control system.



The screen units and assemblies are available in a range of sizes and types, making them adaptable to almost any air moving system. Screen combinations are available to handle air moving requirements from 450 to 80,000 cfm.

More Information? Circle Item 74 on Inquiry Card.

Flexible Cloth Tape Seals Seams

A cloth tape has been developed by Permacel, New Brunswick, N. J., which seals the seams between butted joints of rigid fiber glass and composition-board roof decking. The tape is applied prior to overcoating with a Hypalon and neoprene mixture or poured gypsum. It seals the seams, yet allows enough stretch and flexibility to give with expansion and contraction of the building.

The tape, called Permacel 64, is for general applications not subjected to high temperatures. Heat resistant and flame resistant tapes are also available for higher temperature applications.

More Information? Circle Item 75 on Inquiry Card.

Packaged Electric Storage Water Heater

What is described as the first completely packaged electric storage water heater is introduced by The Patterson-Kelley Co., Inc., East Stroudsburg, Pa.

Designed for commercial and industrial applications this compactly engineered water heater — designated the P-KW — is available for either vertical or horizontal operation. Storage capacities range from 284 to 1300 gallons, with recovery capacities from 41 to 410 gph. Working pressures are 100, 125, or 150 psi. Immersion elements are designed for 208, 220 or 240 volts.

Standard heaters are completely insulated, factory wired and tested. Sturdy skid supports eliminate costly piers and allow the heater to be placed in any suitable area. Electrical and water connections only are required to begin operation.

Circle Item 76 on Inquiry Card.

Corrosion-Resistant Systems

Penton has joined saran in line of corrosion-resistant pipe, valves, fittings and pumps offered by The Dow Chemical Co., Midland, Mich. Dow's trademark for the new products is Pentherm. Linings of Penton will be recommended where chemical resistance at higher temperatures is required.

Penton, trademark of The Hercules Powder Co. for its chlorinated polyether, will be used as a liner for corrosion-resistant systems—as is saran.

The upper temperature limits of saran are established by Dow as ranging from 180 to 200 deg F, depending on application. With Penton, the limit is raised to 225 to 250 deg. Cost of pipes and fittings of Pentherm will be approximately three times that of saran. Installation is equally simple, the company reports.

Circle Item 77 on Inquiry Card.

MAID-O'-MIST Inc.
HEATING SPECIALTIES

automatic

AUTO-VENTS

NO. 7 SERIES

vent air out of hydronic hot water heating and chilled water cooling systems . . . and vent it

continuously!

for VERTICAL MOUNTING

on

- Pipe Lines
- Mains - Coils
- Unit Heaters
- Chillers
- Convectors
- Radiant panels

75 to 150 lbs. pressure
SIZE: 4⅜" x 2¼"

No. 7 Auto-Vent ⅛" I.P. Female Connection.

No. 71 Auto-Vent ¼" Male I.P.T. Connection.

No. 74 Auto-Vent ¼" Female I.P.T. Connection.

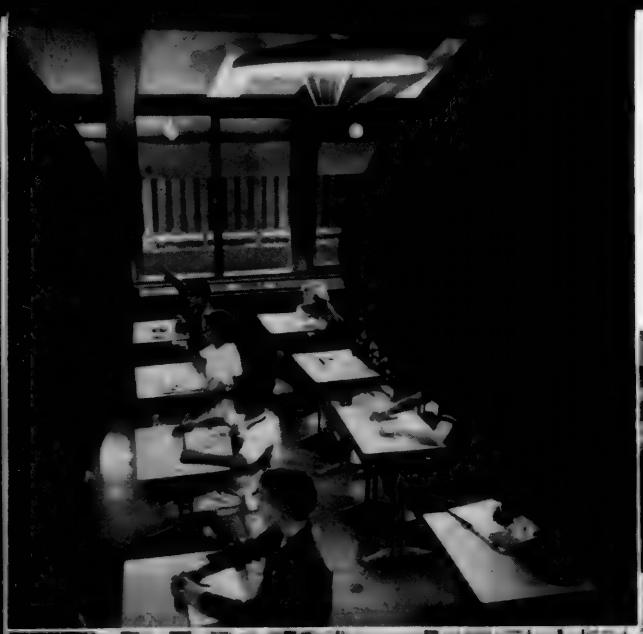
No. 78 Auto-Vent ⅛" Male I.P.T. Connection.

All hydronic hot water heating and chilled water cooling systems collect air in pockets and stop the water from flowing freely. These inexpensive, easy-to-install Auto-Vents get the air out and keep it out because they work automatically with a *float operated valve.* There are four of these efficient trouble-shooters in the #7 series, with male and female connections. Learn more about them!

WRITE FOR CATALOG

MAID-O'-MIST, Inc.

3217 North Pulaski Road — Chicago 41, Illinois

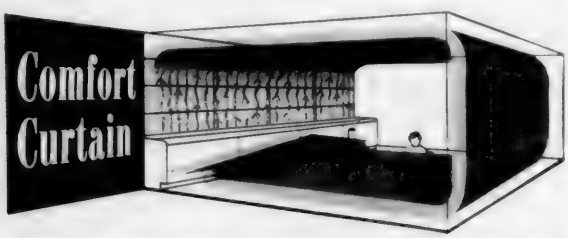


Why ventilate just half a classroom?

The ribbons tell the story! Uniform air distribution . . . the full length of the classroom . . . guarantees room-wide comfort

These children are demonstrating how Lennox COMFORT CURTAIN® provides an ideal climate throughout the entire classroom, rather than just a portion of it. The ribbons indicate how a "curtain" of conditioned air discharges quietly and evenly along the entire length of the exterior wall. Then it moves rapidly up to the ceiling and across to the far wall—well above the occupants—then softly down and through the occupied area in returning to the outer wall. This full perimeter distribution blends and circulates all the air in the room so that its movement measures only 25 to 40 ft. per min. in the occupied area—so gentle as to be unnoticed except for improved comfort. Lennox COMFORT CURTAIN blends and filters fresh outdoor air with heated air and recirculated air. Holds room temperature within ½° of thermostat setting. For complete information about a COMFORT CURTAIN system and its use with all types of heat sources, write LENNOX, 616 S. 12th Ave., Marshalltown, Iowa, or contact your nearest Lennox office.

LENNOX®



©1961 Lennox Industries Inc., founded 1895; Marshalltown and Des Moines, Ia.; Syracuse, N. Y.; Columbus, O.; Decatur, Ga.; Ft. Worth; Los Angeles; Salt Lake City. In Canada: Toronto, Calgary, Montreal, Vancouver, Winnipeg.

...Only

LENNOX

Comfort Curtain® provides full room air circulation

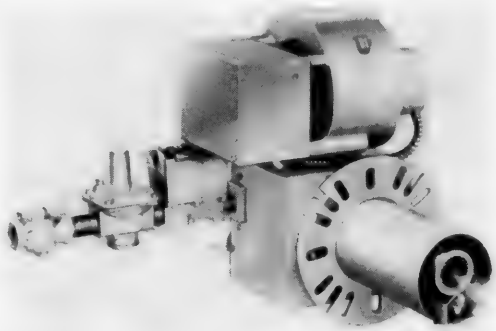
Yet it cost less than $1.10 per sq. ft. to provide individually controlled fresh air ventilating and heating in each classroom of this school

High School—Reorganized School District R-3
Pleasant Hill, Missouri
Matthews and Hillman, Architect & Engineer

No central heating plant, with expensive duct or piping system, was needed in this building. Gas-fired units, in approved heater rooms located between each two classrooms, supply warm air to the COMFORT CURTAIN systems. Simple openings in the exterior walls admit fresh outside air to the equipment in each room. Prefinished wall duct sections, along the entire length of the outside wall in each room, provide the full perimeter air distribution that assures full-room air circulation. Simple structural requirements and ease of installation reduced both initial costs and over-all expenditures. "Day-Nite" thermostats in each room have "no-occupancy" settings to save fuel and make after-hours use of individual rooms economical. Modular design enables new units to be added economically with future building expansion.

Burner Verifies Proper Air Flow

A power burner that electrically determines whether the proper volume of air for good combustion is circulating, is marketed by The Adams Mfg. Co., Cleveland, Ohio.



A 20-second pre-purge period clears the combustion chamber of unburned gases, and establishes a positive draft before opening the gas valve. Immediate shutoff of the gas valve is provided in case of power failure.

The burner has a range of 70,000 to 400,000 Btu per hr and can be used with natural and mixed gases.

More Information? Circle Item 78 on Inquiry Card.

Damper Control Motor

This damper control motor, developed by Brevel Products Corp., New York, N. Y., provides complete cycle function plus positive control. The gear motor, which incorporates cam, switch and brake, is automatically energized when the blower is turned on. The louvers are opened by this motor instead of by the force of air from the blower. The brake causes the motor to stop quickly without coasting and holds the louvers in an open position. When the blower is turned off, the motor is energized again, going through another part of a revolution and closing the louvers tight.

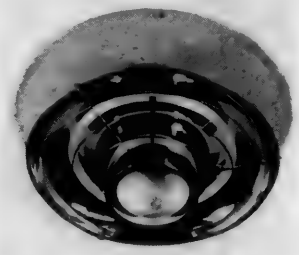
This type of service can be used for opening any door or window, holding it open, and later shutting it securely. Because of built-in flexibility in this gear motor line, small quantities and varying performance requirements are possible.

More Information? Circle Item 79 on Inquiry Card.

2 in 1 Heating-Lighting Fixture

A quartz circular infrared heating-lighting fixture combination, which has a built-in incandescent light, is being offered by Infrared Corp. of America, Hicksville, N. Y.

The 800-watt, 120-volt fixture has a polished aluminum base metal, plated with zinc, copper, and nickel. These metals are also polished to a brilliant



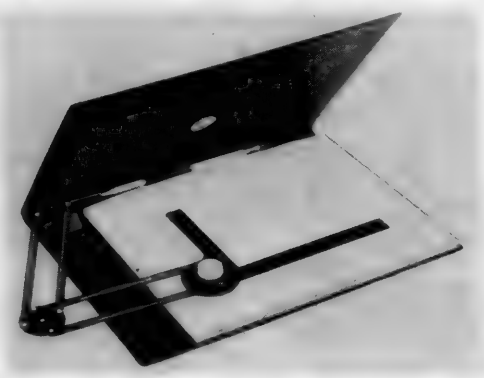
finish and plated with 24-K-gold, resulting in 40% more heat reflection than polished aluminum and greater resistance to weather and atmosphere, according to the manufacturer.

A built-in switch allows the heat to be turned off while the lighting fixture remains in use. Because it is not subject to thermal shock, the fixture can be used outdoors as well as indoors without danger of cracking or breaking the heating element.

More Information? Circle Item 80 on Inquiry Card.

Portable Drafting Kit

A portable drafting kit that provides the advantage of a T-square, triangle, and protractor, all combined in one self-contained binder, is made available by Draftette Co., Beverly Hills, Calif.



The kit includes a drafting instrument, mounted on a vinyl self-locking binder, a scale and 180-degree protractor, pad of 50 sheets of 8½ x 11-inch drawing paper, and pencil. It measures 9½ x 13½ inches, weighs a pound, and can be easily carried or stored in a desk or table.

More Information? Circle Item 81 on Inquiry Card.

Divider-Combiner Valve

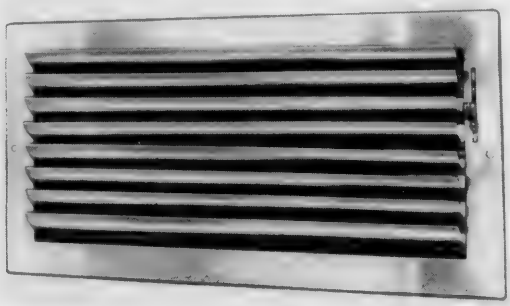
Waterman Hydraulics Corp., Evanston, Ill., announces its Model 1467 flow divider-combiner valve, which can be used as either a divider to divide pump output (up to 40 gpm) into two equal flows or as a combiner to regulate return flow from cylinders.

Besides equal division and combining, the valve may be calibrated to any unequal combination of flows. One or both the divided flows may be redivided with additional valves to synchronize multiple elements. The valve is available with one 1-inch NPTF port and two ¾-inch NPTF ports, and is recommended for pressures up to 3000 psi.

More Information? Circle Item 82 on Inquiry Card.

Adjustable Registers, Grilles

A new series of registers and grilles with curved aluminum blades has been introduced by Air Control Products, Inc., Coopersville, Mich. The curved blades extend beyond the grille face and adjust individually to each installation. Four different face designs are offered, providing one, two, three, or four-way air pattern control. The deflection can be changed easily



to meet the changing seasonal requirements of combined heating and cooling systems. Horizontal multilouver valves in the rear control air volume. The system can be balanced at the face of the register by setting an adjustable stop on the operator handle to limit valve opening.

More Information? Circle Item 83 on Inquiry Card.

QUIET!

and flexibility at its very best!

VERTICAL SEASONVENT

HORIZONTAL SEASONVENT

VERTICAL HEATING & VENTILATING UNIT

McQuay

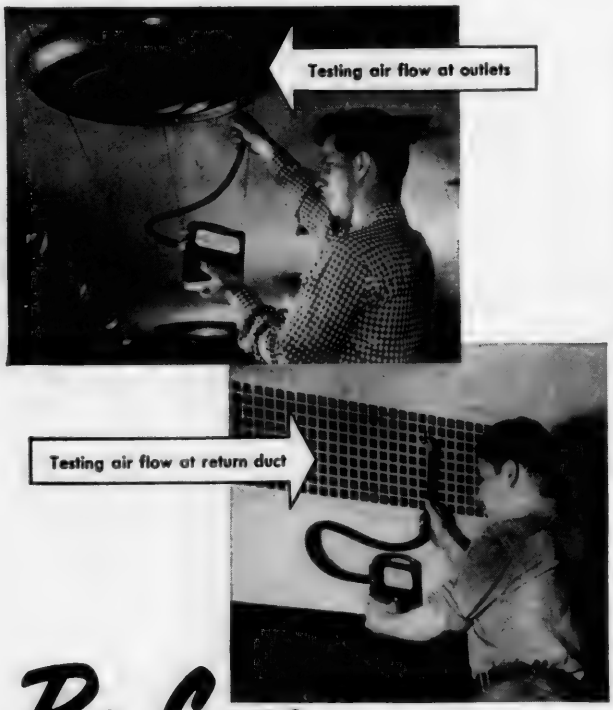
HEATING AND VENTILATING UNITS

McQuay "HC" heating and ventilating units are the most versatile and flexible to be found anywhere with the widest range of coil selection in the industry, and with capacities for vertical and horizontal models up to 48,330 cfm in nineteen sizes. They are designed for horizontal, vertical, wall and inverted installations for use with or without duct work. They can be used with hot water or steam, with or without duct work, and will fill the needs of every installation.

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

The McQuay Seasonvent is engineered specifically for auditoriums and theatres where quiet operation is demanded. This large capacity heating and ventilating unit is also extremely versatile and flexible with nine sizes for low static applications (0" to 1¼" s.p.) and seven sizes for high static installations. Capacities range from 1,250 to 15,000 cfm. Contact your nearest McQuay representative for complete information, or write to McQuay, Inc., 1619 Broadway N. E., Minneapolis 13, Minnesota.



Be Sure the first time
in balancing air flow systems

The Alnor Velometer®

gives a quick accurate check of air movement at outlets, returns, plenum chambers, static pressure in ducts, friction loss at ells and deflectors.

Readings are made directly in f.p.m. on the Velometer dial. So sensitive, readings as low as 20 f.p.m. can be made. The triple range scale registers up to 3000 f.p.m. and 6000 f.p.m.

Velometer Set No. 3G

Recommended for the air conditioning, heating and ventilating contractor. Consists of the Velometer with rugged carrying case, angle supply jet, suction (return) jet, static pressure jet, Price f.o.b. Chicago $194.

Velometer Jr.

For quick simple checking at outlets where attachments are not required. A compact instrument only 4" x 3" x 1½". Capacity ranges

0—200 f.p.m. to 800 f.p.m.
0—400 f.p.m. to 1600 f.p.m.
0—500 f.p.m. to 2500 f.p.m.

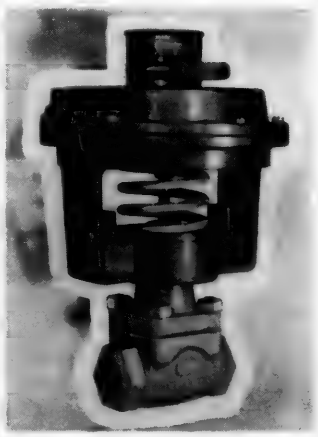
Price, with genuine leather carrying case, $44.00 f.o.b. Chicago. All models carried in stock for immediate delivery.

Alnor INSTRUMENTS

ALNOR INSTRUMENT CO.
Division of
Illinois Testing Laboratories, Inc.
Rm. 570, 420 N. LaSalle St., Chicago 10, Ill.

Valves Regulate Small Air Flows

A line of compact valves for regulating the flow of small streams of air in industrial processes and commercial building applications has been introduced by Valve Div., Minneapolis - Honeywell Regulator Co., Fort Washington, Pa.



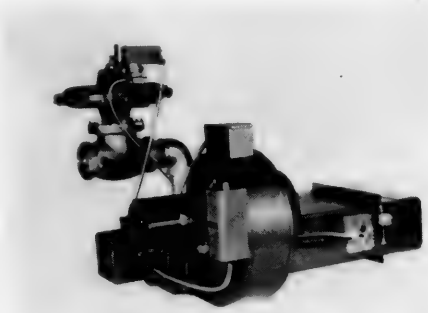
The new line, called the 1400 series, includes a lightweight diaphragm - actuated model, a high performance diaphragm model, an ultra-low-flow model, and two models having electric actuators.

The valves are available in three body sizes (½, ¾, and 1-inch) with a wide selection of reduced inner ports and a range of materials and body ratings with both screwed and flanged connections.

More Information? Circle Item 84 on Inquiry Card.

Heavy Duty Industrial Burners

Roberts-Gordon Appliance Corp., Buffalo, N. Y. now offers a new series to its existing line of heavy duty industrial burners. The PX Series burners range in sizes from 1,000 to 3,000,000 Btu input per hour. All PX burners are constructed from heavy-duty pressed steel and can accommodate most industrial or commercial boiler applications.



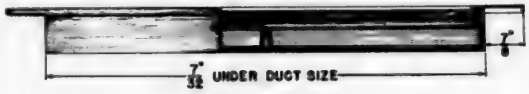
These burners are a complete package, ready for installation with the latest electronic safety controls used in conjunction with various control components, making it possible to offer a high quality, safe, and efficient firing device at extremely competitive prices. Design incorporates method of proportioning all combustion air required to insure highest combustion efficiency independent of uncertain varying stack draft.

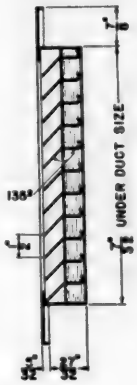
More Information? Circle Item 85 on Inquiry Card.

NEW from A-J!

A-J No. 22 Series

Rain and Snow-Proof EXTERIOR STATIONARY LOUVER





Here's ventilation or fresh air intake plus weather protection conveniently combined in a single unit! Completely bird-proof. This stationary exterior louver has closely spaced horizontal bars on ½" centers. The louver unit is 13/16" in depth, and manufactured 7/32" under listed size. All-steel construction throughout on the No. 22 style.

The No. A-22 has an extruded aluminum frame and bars of Armco Aluminized steel which gives an unbeatable combination of strength and durability for long-time exterior application.

Aluminum bug screen available at additional cost.

FREE catalog contains complete identification and selection.

Write for your copy.

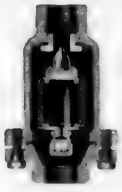
A-J MANUFACTURING CO.

Dept. V-9 3601 E. 18th St.

Kansas City 27, Mo.

GET RID OF HARMFUL AIR RAPIDLY! POSITIVELY! AUTOMATICALLY!

...with Sarco air eliminators and air vents



...FROM MECHANICAL STEAM TRAPS... STORAGE HEATERS...WATER HEATERS, ETC.

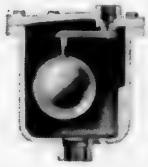
Air in a steam system lowers temperature — retards heat transfer — uses more fuel — slows warm ups — binds steam traps. You can get rid of it easily and economically with Sarco Thermostatic Air Vents, Type VS. Here's how:

The temperature-sensitive element closes and opens the air vent automatically, on the balanced pressure operating principle. It opens to discharge a low temperature air/gas mixture; closes as soon as pure steam temperature is reached. There's no chance of human error. Steam pressures to 225 psi.

...FROM DRY RETURN LINES OF TWO PIPE LOW PRESSURE OR VACUUM HEATING SYSTEMS

Sarco Float Type Air Eliminators (non-thermostatic) will do the job. Its vacuum check allows air to escape, and closes to prevent air passing back into the system. Type 6 for small capacities; Type 13S for large. Another, Type 6T, has a float plus a thermostatic bellows for use where steam, air and condensate may be present, as in one pipe heating system. Steam pressures to 15 psi.

...FROM WATER HEATING OR COOLING SYSTEMS



You'll eliminate the air pockets which prevent or retard circulation if you install Type 13W or 13WH Sarco Air Eliminators at each high point in these applications: convector or radiant hot water heating systems; high pressure, high temperature hot water; circulatory chilled and condenser water lines in air conditioning installations; process liquid lines. Pressures to 150 and 300 psi.

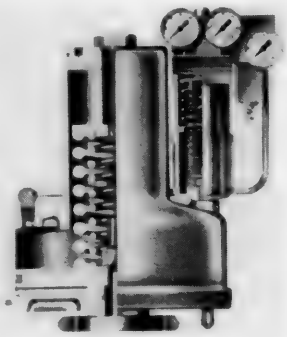
For more information, contact your Sarco sales representative, district office, or distributor, or write. 5962

SARCO

SARCO COMPANY, INC.
[illegible] MADISON AVE. NEW YORK [illegible] N. Y.
PLANT: [illegible] BETHLEHEM, PA.
STEAM TRAPS • TEMPERATURE CONTROLLERS
TRAINERS • HEATING SPECIALTIES

Pneumatic Actuators Introduced

Security Valve Co., South Pasadena, Calif., announces Series P pneumatic positioning actuators, designed for signal pressures in the 3 to 15 psig range or as required.



The actuators have a position accuracy of 0.1% of the stroke. The positioner is completely adjustable from the outside which eliminates the time consuming cut and try starting air and span adjustment associated with many existing designs. They are furnished in either air-to-open or air-to-close action and are fully adjustable in the field. Helper springs provide fail-open or fail-closed action to assure positive extension retraction of cylinder rod on air failure.

Additional applications include control of pump speed, position louvers, cams, thermostats and other devices requiring precise and/or powerful actuation.

More Information? Circle Item 86 on Inquiry Card.

Alarm Monitors Liquid Levels

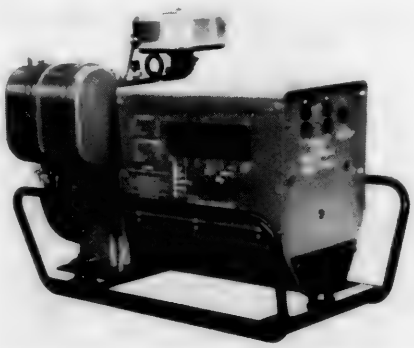
An electric "watchdog" that sounds an alarm, automatically shuts off pumping equipment, opens or shuts solenoid valves, or cuts in auxiliary supplies whenever a specific liquid low or high level is reached is being marketed by Everpure, Inc., Chicago, Ill.

This electrically controlled liquid alarm features a buzzer that can be heard at least 50 feet away. With a simple alternate wiring installation, it can start or stop a pump, and energize or de-energize solenoid valves when the critical liquid level is reached.

More Information? Circle Item 88 on Inquiry Card.

Power and Welding Generator

Miller Electric Mfg. Co., Appleton, Wis., announces the Memco Bantam, a gasoline engine driven welder, power plant, and pipe thawer.

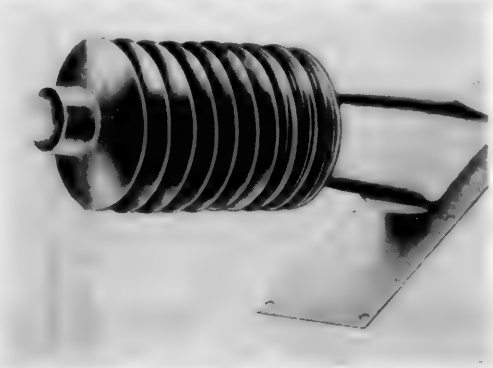


The Bantam's 12.3 hp single cylinder Kohler air-cooled engine drives a rotating field generator to produce 180 amps of a-c welding power in a 100% duty cycle; 3.5 kw of 115v 60-cycle single-phase power, and 1 kw of 115v d-c power while welding.

More Information? Circle Item 89 on Inquiry Card.

Pliable, Coated, Fiberglass Sleeves

A silicone coated, fiberglass material is being used in the manufacture of pliable, accordion-type protective sleeves by A & A Mfg. Co., Inc., Milwaukee, Wis. The sleeves can serve as ducts for hot gas transfer between intake and exhaust of industrial furnaces.



The material resists ambient temperatures as high as 450 deg F, and flexes without cracking at temperatures as low as —80 deg.

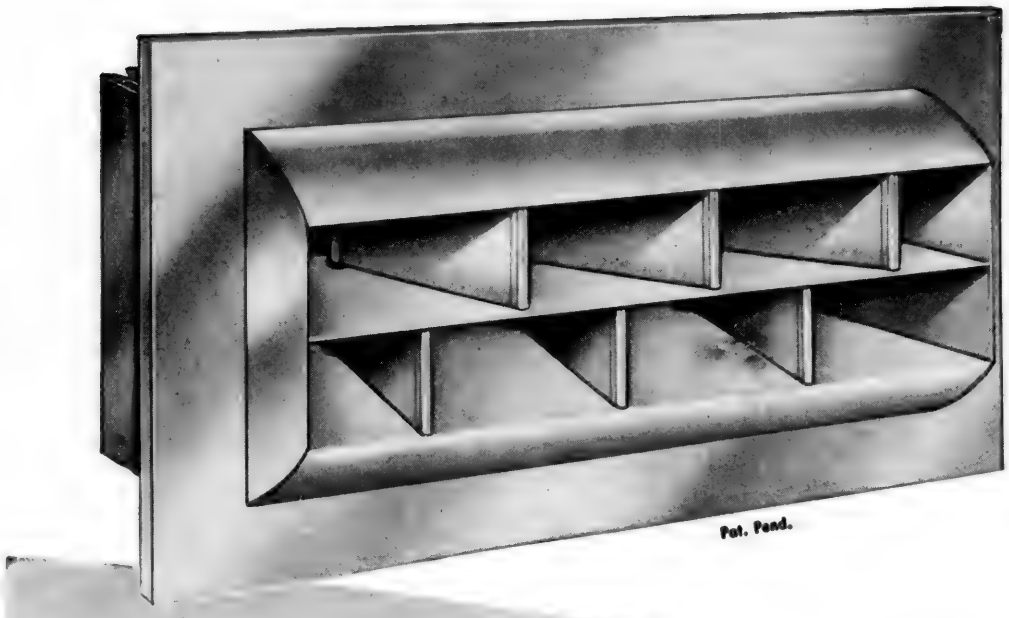
More Information? Circle Item 87 on Inquiry Card.

Flexible Air Duct

A 14-inch ID flexible air duct, believed to be the first duct in this size for air conditioning use, has been introduced by The Wiremold Co., Hartford, Conn.

Made in 10-foot lengths, the new diameter duct is available in three types: Type 57, for general air conditioning use; Type 52, for use in New York City; and Type 5J, to meet Chicago requirements. Wiremold air duct is used as a connector or branch duct on the supply side of central air conditioning systems.

More Information? Circle Item 90 on Inquiry Card.



WITH ENGINEERED JET INDUCTION DIFFUSING VANES

Pat. Pend.

EXTRUDED ALUMINUM

AGITAIR ROTO-JET diffusers

FOR LONG PROJECTION OR MODULATED DIFFUSION
ADJUSTABLE — UP OR DOWN... LEFT OR RIGHT

Agitair ROTO-JET Diffusers designed and developed by Air Devices Inc. engineers are recommended for those applications where long projection or modulated diffusion of heated or cooled air must be directed to cover extremely large interiors.

The versatility of these diffusers permits distribution of air in an upward or downward projection, also left or right when desired. ROTO-JET Diffusers can be mounted either horizontally or vertically.

Your local Air Devices Inc. representative, with practical on-the-job engineering experience in air distribution, is prepared to assist you in the application and sizing of ROTO-JET diffusers to meet your requirements.

Your Best Bet Is ROTO-JET

For use in... factories • gymnasiums • auditoriums • sport centers • supermarkets • bowling alleys • missile plants • aviation plants • airport terminals • power plants • automobile factories elevator switching and machine rooms; as air curtains. Ideal for use in any other structure where large interior areas must be blanketed with heated or cooled air.

FEATURES:

ROTARY CYLINDER — The rotating cylinder permits the projection of air upward or downward 30° from the centerline. This feature is ideal for those applications where long projection or modulated diffusion of heated or cooled air must be directed to cover extremely large interiors.

ADJUSTABLE DIFFUSING VANES — Only cylinder type ROTO-JET diffusers employ the individually and manually adjustable split diffusing vanes.

For long projection applications, the vanes are set straight out producing nozzle type throws.

When vanes are set at angles diverging from the centerline, the degree of spread may be controlled.

MODULATED DIFFUSION — The split vanes design provides an additional feature only employed in ROTO-JET DIFFUSERS. When the top row of vanes are adjusted to the left or right and the bottom vanes are in opposite directions, they produce diverging and counter-flowing jet air streams which create a high degree of turbulence, instantaneously mixing the primary and room air and resulting in rapid temperature equalization. The length of blow may be extended or shortened according to the amount of counter-flow resulting from vane settings.

SEND FOR CATALOG RJ-100

AIR DEVICES INC.

185 MADISON AVENUE, NEW YORK 16, N. Y.

BETTER PRODUCTS FOR
AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

SOFTITE® BY WHEELING

"TOPS FOR EVERY SHAPE!"

That's what sheet metal men all over America say about Wheeling SOFTITE COP-R-LOY Galvanized Sheets! Here's why: 1. SOFTITE works easier because it is soft and ductile. 2. SOFTITE's galvanized coating is actually part of the steel base, can't flake or peel no matter how it's tortured. 3. SOFTITE, made of famed COP-R-LOY steel, gives years of extra service. Get the full story on dependable, easy-to-work SOFTITE COP-R-LOY Galvanized Steel Sheets from your Wheeling man. Or write directly to Wheeling Corrugating Company, Wheeling, W. Va.

IT'S WHEELING STEEL!

WHEELING STEEL CORPORATION

DISTRICT OFFICES:				
Atlanta	Buffalo	Cincinnati	Houston	St. Louis
Boston	Chicago	Cleveland	New York	San Francisco
		Detroit	Philadelphia	Wheeling

WHEELING CORRUGATING COMPANY Subsidiary

Atlanta	Columbus	Louisville	New York
Boston	Detroit	Martins Ferry	Philadelphia
Buffalo	Houston	Minneapolis	Richmond
Chicago	Kansas City	New Orleans	St. Louis

NEW ANEMOSTAT PLANT

Combines finest, most efficient production and research facilities in the air conditioning industry.

- Manufacturing Area = 165,000 sq. ft. in modern, one story building.
- Research and Development Area = 10,000 sq. ft. with complete facilities for radiated sound power measurement of air flow and temperature equalization.
- Three Test Chambers = two, specially constructed to provide reverberant room for sound measurement through all frequency bands in conformance with the recommendations of the ASHRAE Standards Project Committee.
- Monitor Master Panel Board = for recording and controlling all conditions throughout each chamber.
- Climatic Test Window = for demonstrating and testing all heating and cooling problems.
- Hydraulic-Electric Moveable Floor = for varying floor to ceiling heights.

These new facilities will help us to serve you better — deliver faster and have room to expand to meet the growing needs of the air conditioning industry. From our Research and Development program will come the units that will be the standard of excellence in tomorrow's buildings.

You are cordially invited to examine these outstanding facilities.

ANEMOSTAT®

ANEMOSTAT CORPORATION OF AMERICA
SUBSIDIARY OF DYNAMICS CORPORATION OF AMERICA
Factory and Offices: 888 North Keyser Avenue, Scranton, Pa.
General Sales Offices: 25 West 43rd Street, New York 36, N. Y.
Representatives in Principal Cities

AC-1961

ENGINEERING INSTITUTE

(Continued from page 12)

It is believed that this is the kind of atmosphere most conducive to learning.

Inquiries concerning the Institute registration procedures should be directed to Mr. Busby, 3040 Stadium, The University of Wisconsin, Extension Division, Madison 6, Wis.

AUTOMATIC WEATHER STATION POWERED BY ISOTOPES

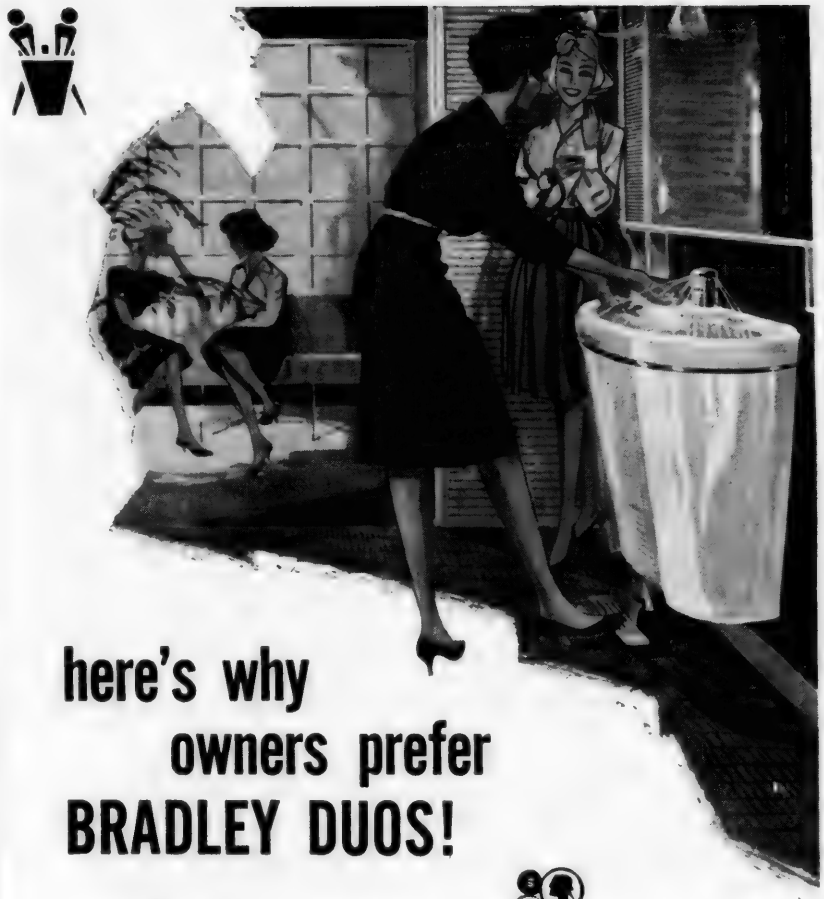
The world's first isotope-powered, automatic weather station will go into operation in the Canadian Arctic, it was announced jointly by the Department of Transport of Canada, the U. S. Atomic Energy Commission and the U. S. Department of Commerce Weather Bureau.

A dream of meteorologists for many years has been to obtain automatic weather observation from strategically located remote areas. Unfortunately, many of the desired locations are relatively inaccessible and to establish manned stations would present such problems as recruiting an isolation staff and maintaining resupply operations.

An automatic weather station, capable of functioning unattended for up to two years, has now been developed. Earlier difficulties, created by lack of a continuous power source have been eliminated by the use of isotope power.

The U.S. Atomic Energy Commission and the U.S. Weather Bureau spearheaded activity in the design and fabrication of equipment to provide reliability consistent with the long life of the isotope, to use a minimum of electrical energy and to provide accurate weather data in usable form. The station has undergone extensive tests in Baltimore and is ready for installation.

(Continued on page 138)



here's why owners prefer BRADLEY DUOS!

SANITARY!

Just a touch of the toe serves clean, tempered water. There are no germ-laden faucets to fuss with — hands touch only the clean spray. Duos are self-rinsing, too.

ECONOMICAL!

One Duo can do the work of two conventional basins — yet requires only one set of plumbing connections! This feature saves money, valuable space, and water.

CONVENIENT!

Users appreciate Duos. So do maintenance men, since the Duo's foot pedal swings up and out of the way for easy floor cleaning. A removable front panel makes them very easy to service, too.

HANDSOME!

Trim, contemporary Duos are available in stainless steel and in six vitreous enamel colors. A stainless steel Duo with integral back panel also is available.

Bradley Washfountains and Showers provide group facilities for as many as 8 and 5 persons respectively . . . in schools and in commercial, industrial, and public buildings. For additional information, see your Bradley representative. Or write for Publication No. 1380 to: Bradley Washfountain Co., 2352W. Michigan Street, Milwaukee 1, Wisconsin.

Bradley

Circular, semi-circular, and Duo Washfountains serving as many as 8 persons simultaneously.

Column, partition, and wall-mounted showers serving as many as 5 persons simultaneously.

61-114-R1

INCREASE EFFICIENCY AND DECREASE COSTS WITH METROPOLITAN MAINTENANCE PRODUCTS

DUBOTH®
BOILER FEED WATER TREATMENTS
VAPORENE®
AIR CONDITIONING WATER TREATMENTS
SLUDGOUT®
FUEL OIL ADDITIVE FORMULATIONS
SOOTRACIDE®
SOOT AND SLAG ELIMINATOR
EZ TREAT®
COMPLETE TREATMENT FOR SMALL AIR CONDITIONING
DESCALER®
AIR CONDITIONING AND BOILER SCALE REMOVERS
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STEAM & RETURN LINE TREATMENT
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TREATMENT FOR GENERAL WATER SUPPLY SYSTEMS

As They Have For 40 Years, Engineers Everywhere Today Rely On METROPOLITAN'S Quality Chemical Maintenance Products And Consulting Services.

Through Scientific Field Surveys And Laboratory Analyses METROPOLITAN Works Closely With You To Find The Right Answers To Your Specific Problems.

To Prevent Or Eliminate Problems Of Scale, Corrosion, Slime, Soot, Slag, Sludge Caused By Impurities In Water And Fuels . . . In Boilers, Cooling Towers, Evaporative Condensers, Storage Tanks, Steam & Return Lines, General Water Supply Systems . . . In Industrial Plants, Office Buildings, Apartment Houses, Public Institutions, Hotels, Theaters, Stores . . .

ASK FOR THE MAN FROM METROPOLITAN. HE HAS THE CHEMICAL SOLUTION FOR YOU.

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LONG ISLAND CITY 1, N.Y.

AUTOMATIC WEATHER STATION

(Continued from page 137)

The close cooperation maintained between the U.S. Weather Bureau and the Canadian Department of Transport prompted the latter's Meteorological Service to suggest that the station be installed for trial and operational use in the Canadian Arctic. As a result, it will be located on remote, uninhabited Graham Island in the vicinity of Norwegian Bay, about midway between the Canadian weather stations at Eureka and Resolute.

The station and power source are housed in a cylindrical, insulated container, approximately eight feet long. The lower five feet will be buried in the permanently frozen ground.

Reliable and rugged meteorological instruments—an anemometer, thermometer and barometer—mounted as integral parts of the station will measure wind direction and speed, temperature and barometric pressure. These readings will be fed into a data processing system and will emerge ready to go directly into the radio transmitter, which in turn will relay them every three hours to the receiving stations at Resolute and Alert. The anemometer and thermometer will be exposed on a tower beside the station while the barometer will be placed within the cylinder along with recording equipment, radio and transmitters, anenna and other electrical apparatus.

One of the station's unique features is the power source, located in a lower chamber of the container. Consisting of a strontium-90 heat generator and thermocouples, batteries, and a converter, it uses an insoluble chemical form of the isotope strontium-90 securely locked in a corrosion-resistant capsule and shielded by three quarters of a ton of lead. The excess heat from the strontium-90 is used to maintain an interior operating temperature of approximately 70 degrees F. This element produces thermal energy which when converted into electricity charges the nickel-cadmium storage battery system, which in turn activates the radio transmitter. The isotope strontium-90 has a

relatively long half-life and is capable of producing usable power for over ten years. The compound used, strontium titanate, is insoluble and biologically inert, with a melting point so high that it could not be dispersed by the hottest gasoline fires.

THREE NATIONAL CODES GOVERN WATER HEATER MANUFACTURE

Today, there are three national codes which control the design, materials, fabrication and performance of all commercial, industrial and institutional water heaters, a recent engineering seminar conducted by Ruud division of Rheem Mfg. was told. They are the American Gas Association (A.G.A.) Laboratories, the National Sanitation Foundation (N.S.F.) Testing Laboratories and the American Society of Mechanical Engineers (A.S.M.E.).

American Gas Association

A.G.A. Laboratories, founded in 1925, set up basic standards for safe operation, substantial and durable construction, and acceptable performance. Later when 180-deg hot water delivery became essential, special requirements were set up. A further development has been the establishment of three classifications of commercial gas water heaters: circulating tank heaters which must be connected to an external storage tank, automatic instantaneous to supply instant hot water on demand, and automatic storage, a free-standing unit without an external storage tank.

From these classifications derive the A.G.A. "use-approvals," which, if followed, make certain the specification and installation of a water heater of correct design for each application.

National Sanitation Foundation

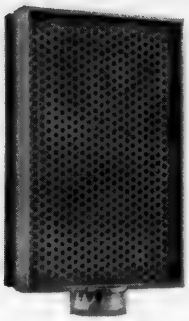
NSF codes dealing with commercial dish-machines of special interest to food service establishments are Standard No. 3 for commercial spray-type dish-machines and No. 5 for commercial water heaters supplying 180-deg sanitizing rinse water to those

(Continued on page 140)

MEARS electric heat thermostats . . .

Designed for modern wall-to-wall comfort

North Raleighwood home of D. P. Mather



The MEARS M7 family of fine trim-line thermostats serve every requirement of electric heating. The leader in **modern comfort control . . . handsome design . . . constant reliability.**

The new Mears M7 literally "hugs" the wall . . . has that "built-in" look of belonging. Available in **single pole, double pole, load transfer** and **modulating models.**

INDUSTRY'S WIDEST RANGE (35° to 90°F)
The lowest dial position turns on heat when there is danger of freezing . . . gives excellent control in vacant houses, greenhouses, garages.

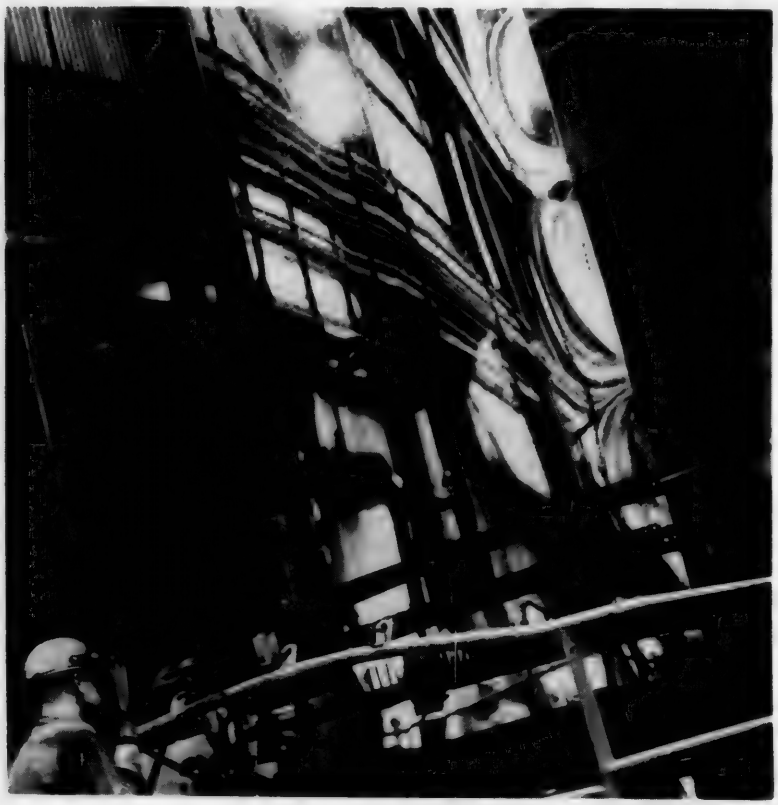
SNAP ACTION SWITCH. Positive, instant response. No "sizzling," arcing, or burning of contacts, no radio or TV interference. An audible "click" lets you know when the thermostat has been adjusted to a new setting.

FULL PERIMETER VENTILATION. The Mears M7 is extra sensitive to both convected and radiated heat. Its perimeter ventilation—plus bi-metal sensing element—makes the M7 thermostat more sensitive to temperature changes than the human body.

See the **"MAN FROM MEARS"** in your area—or write today for your free copy of the **MEARS CONTROL CATALOG.** Dept. AC-9.

This new 26 page catalog describes the complete line of Mears controls for electric heating. It includes wall mount and inbuilt styles, surface sensing units for water heaters, load regulators, plus a valuable section on electric heating terms and definitions.

MEARS CONTROLS *Inc.*
13725 S. W. Millikan Way • Beaverton, Oregon

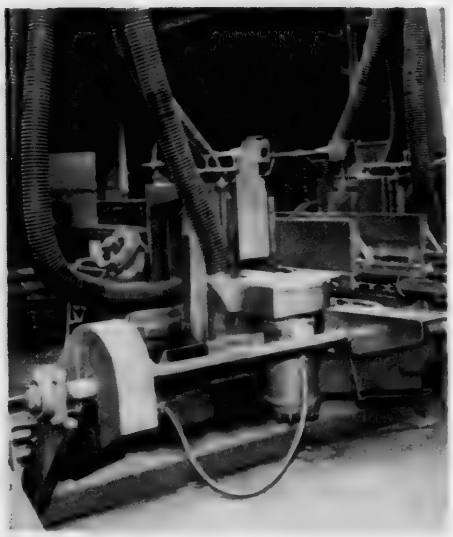


NEW GALVANIZING UNIT—This freshly coated 72-inch-wide strip of galvanized steel is being produced on Armco Steel Corporation's seventh continuous zinc-coating line. The new line, at the company's Middletown, Ohio, Works, produces the widest zinc-coated sheet available in the steel industry.

FLEXAUST® HOSE

Dust Collection for Fume Control Materials Handling

MAKES GOOD INSTALLATIONS BETTER



Thousands of successful installations prove that use of Flexaust hose and Portovent retractable duct with metal duct systems lower installation costs — but there are other important advantages.

Exceptional abrasion resistance
Corrosion resistance
Noise absorption
Durability under heavy flexing
Provision for expansion and contraction
Easy relocation of hoods and machines

Made of high quality neoprene coated fabrics 1¼ to 36" i.d.

Write today for full details

Distributors in all principal cities

THE FLEXAUST CO.

DEPT. HV-9 100 PARK AVE. NEW YORK 17, N. Y.

THREE WATER HEATER CODES

(Continued from page 139)

machines. These codes have revolutionized the commercial water heater industry. Required hot water quantity has increased greatly and code-demanded 180-deg temperatures have made for drastically changed design in the past few years. Many states, counties and cities have written Standard Nos. 3 and 5 into their own public health codes, and the number of such localities is increasing. Multiple units have been approved by the N.S.F. Testing Laboratories.

ASME Codes

A third code is the A.S.M.E. Boiler and Pressure Vessel Code covering materials, methods, construction and tests for steel-plate boilers. This code, within the past few years, has been applied by states and cities to all water heaters with an hourly input of over 200,000 Btuh.

AFI MEMBER

AIRSAN Req U S Pat Off GREASE FILTERS

✓ **PERMANENT, CLEANABLE TYPE AG**
Made especially for range canopies, galleys, kitchens, ventilation systems.

✓ **EXTRA HEAVY CONSTRUCTION**
Provides better thermal mass to resist "burn-outs." Offers longer service. Also available in stainless steel enclosing frames.

✓ **PRE-ASSEMBLED UNITS for CEILING or Walls**
Completely pre-assembled units available . . . just set in place and bolt together. Save time and labor costs. Eliminates complex assembly problems. Available in stainless steel, steel, aluminum.

REDUCE FIRE HAZARD PROBLEMS resulting from grease laden fumes as **AIRSAN GREASE FILTERS** prevent grease from entering exhaust ducts, protect motors . . . increase working comfort.

For Safer kitchens in Hospitals, Industrial Plants, Hotels, etc. Write for Bulletin G505

Air Filter Corporation

A few distributorships available. Write for details!
Send for FREE Bulletins!
4554-S West Woolworth Ave., Milwaukee 18, Wis.

NEW! Waterproof!

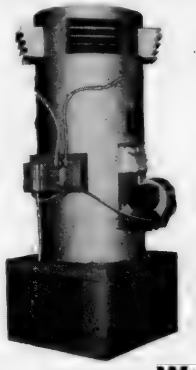
NOW STANDARD ON ALL REGULARLY CATALOGUED JE SOLENOID VALVES

New epoxy-clad coils are line-tested at 2300 volts completely submerged in water. Eliminate coil failure! Impervious to almost anything and everything—condensation, fluid spray, frost, oil, gasoline and other corrosive liquids and vapors. Unlimited indoor or outdoor applications. U.L. listed. Wire, write, or phone:

CONTROLS DIVISION **JACKES EVANS MFG. CO.**
4427 GERALDINE AVENUE • ST. LOUIS 15, MO.

LOW COST PLANT HEATING!

SAVE ON FIRST COST
SAVE ON INSTALLATION COST
SAVE ON OPERATING COST



Thermobloc Direct - Fired Warm Air Heaters furnish the ideal solution to the problem of high heating costs. Thermobloc heaters are made in a complete range of sizes for all commercial and industrial uses. They are completely automatic — give years of trouble-free-service. There is no wasted heat — Thermobloc puts heat where it's needed, when it's needed.

Write for Information today

WANSON CORPORATION
Lewistown, Pennsylvania

THERMOBLOC
THE WORLD'S LEADING AIR HEATER

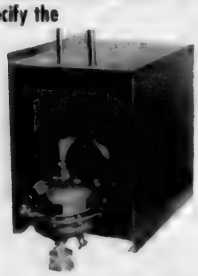
( ) Please send new Bulletin on Industrial Heating
( ) Have representative call to explain possible economies of Thermobloc.

Name .....
Company .....
Street .....
City & State .....

proper air-conditioning system design demands a P.C.* factor!

*"people-comfort"

Air-conditioning systems that fail when needed most, create "people-comfort" problems that could have been eliminated on the design board. Many system failures can be traced to automatic controls that have been rendered useless due to moisture and oil clogging. These contaminants are carried into the vital control mechanisms by the compressed air that actuates them. Wise air-conditioning engineers specify the



HANKISON Series-E AIR DRYER

. . . economically and easily installed in an existing or new system . . . eliminates oil, water vapors and entrainments by precipitating and trapping off these harmful contaminants from the compressed air before they reach the thermostatic controls . . . added assurance that the system you design will operate at peak "people-comfort" efficiency.

For complete information, write today for bulletin 9300

PREFERRED for practical air drying

Hankison CORPORATION

College and Pike Canonsburg, Pa.

(Greater Pittsburgh Area)

BRIEFLY STATED

NEWS ITEMS

Robert K. Moss, professional engineer and ASHRAE member, announced the formation of a new consulting organization to be known as ROBERT K. MOSS, CONSULTANTS. Company headquarters and offices are being located at 2252 Dehne Road, Northbrook, Ill. Mr. Moss, formerly vice-president of the Dell Corporation of Morton Grove, has had over fifteen years of theoretical and practical experience in the field of heating and air conditioning. The company will render consultation services to architects and contractors on the problems involved in any type and size of heating or air-conditioning project. . . .

Dr. John N. Dempsey has been named by MINNEAPOLIS-HONEYWELL as director of its Research Center and associate director of the company's over-all research activities. As director of the Research Center, Dr. Dempsey succeeds Dr. Van W. Bearinger, who has been appointed general manager of Honeywell's Semiconductor division. Dr. Bearinger also was director of research for the company. Dr. Dempsey, 38, has been assistant director of the Center since 1960, with responsibility in the fields of infrared and ultraviolet sensors, ceramics and solid-state physics. He joined the company in 1952. He will supervise the activities of nearly 200 scientists and technicians, who are engaged in programs ranging from metallurgy and thermodynamics to physical electronics and deep-ocean research. . . .

Appointment of Jack Miller to the technical department of the PLUMBING INDUSTRY PROGRESS & EDUCATION FUND (P.I.P.E.) is announced by Milton E. Jeanney, executive director of the Fund that promotes public understanding of quality and service standards in the plumbing industry.

According to Jeanney, the Fund

All New Webster DUAL FUEL CYCLONETIC* Burner

Superior

in any

Configuration

* TRADE MARK

Write for Literature

WEBSTER ENGINEERING

TULSA 9, OKLAHOMA

a division of Midland-Ross Corporation

recognizes that lack of standardized specifications and mechanical plans, which often cause costly delays in building construction, are one of the major problems confronting the plumbing industry. Many of the present specifications and plans are so vague in their language that they reduce "estimating" to "guesstimating." Mr. Miller has been appointed to study ways and means of correcting this problem.

Mr. Miller formerly was associated with Norman Engineering Co., Inc. of Los Angeles as project manager; Hinkston & Norcross, Inc. of Los Angeles as project manager; and Pereira-Luckman & Associates of Los Angeles as junior engineer. . . .

* * *

The 1961 (3rd) SOUTHEASTERN PLANT ENGINEERING AND MAINTENANCE SEMINAR will be held September 12, 13, and 14 in the Town Hall and Coliseum in Greensboro, N.C. It is sponsored by chapters of the American Institute of Plant Engineers.

On Wednesday, September 13, R. G. Werden, president and consulting engineer, Valley Engineering Company, Glenside, Pa., will speak on design, operation, and maintenance of industrial air conditioning.

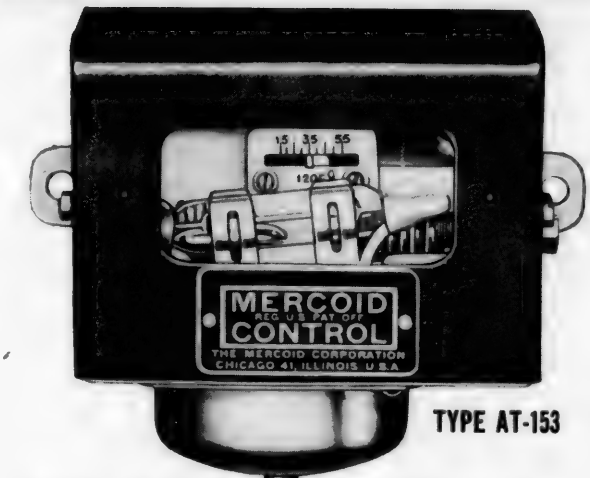
A fee of twenty dollars covers the complete seminar and banquet. A fee of five dollars, each covers participation in each of the three days of seminars.

The Seminar's companion event, the Southeastern Show, will feature equipment, supplies, and services covering every aspect of plant engineering and maintenance. Over 200 companies will exhibit.

BURGEONING BUSINESS

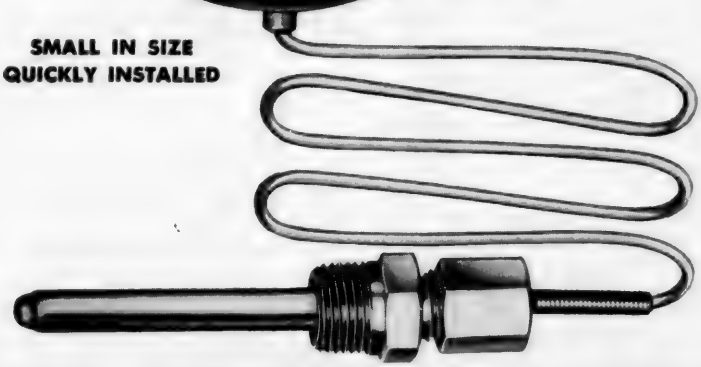
Wade in Canada announces that the recent purchase of Wade Manufacturing Company, of Elgin, Illinois, by Josam Manufacturing Co., of Michigan City, Indiana, *did not* include Wade in Canada, Plumbing

NEW
TEMPERATURE CONTROL



TYPE AT-153

SMALL IN SIZE
QUICKLY INSTALLED



FOR REFRIGERATION—AIR CONDITIONING—FREEZE PROTECTION AND VARIOUS INDUSTRIAL APPLICATIONS

CIRCUIT

SP-DT HERMETICALLY SEALED MERCURY SWITCH (4A. 115V., 2A. 230V.)

Provides any of the following operations:
Single Pole—cut in high (close on rise)
Single Pole—cut in low (open on rise)
Single Pole—Double Throw

OPERATING RANGE

Operating Range °F.	Min. Differential °F. (Fixed)
15 to 55°	2.5°

Exclusive Features

EXTERNAL ADJUSTMENT
VISIBLE CALIBRATED DIAL
VISIBLE SWITCH POSITION
SEALED MERCURY CONTACT

WRITE FOR
BULLETIN NO. 0-28

MERCOID CONTROL
THE MERCOID CORPORATION
4209 Belmont Ave., Chicago 41, Ill.

Why take less . . . when CORDLEY offers *more:*

More Cooler Experience. Water Coolers are Cordley's *only* business, not a side line.

More Assurance of Satisfaction. Cordley's full 5-year guaranty is by far the strongest in the industry.

More Help in choosing the right coolers for your use...from Cordley's line of 28 job-rated models. 4101

The New CORDWALL LINE

No plumbing shows. Flush to the wall. No dirt can get behind. 3 wall models for installation at any height. 5 floor models. See Yellow Pages for nearest Cordley Distributor. Ask for Catalog 61.

CORDLEY & HAYES
Specialists in water cooling since 1889
443 Park Avenue South, New York 16, N.Y.

Briefly Stated

Specialties, Limited. Wade in Canada is now operating as a Canadian corporation, completely independent of the United States' Josam and Wade companies, and Josam Products Limited, in Canada. It is further stated that the Canadian Wade Company is now manufacturing all of its products in Canada.

Crane Company acquired the operating assets of AllianceWare Inc., a subsidiary of American Metal Products Co. The assets include inventories and five manufacturing facilities; a plant in Alliance, Ohio, which produces AllianceWare pressed steel plumbing fixtures and AllianceWall, a porcelain-on-metal product used in construction and remodeling; two potteries located in Somerset, Pennsylvania, and Evansville, Indiana; and two enameling plants located in Colton, California, and Kilgore, Tex. Heretofore Crane Co. had not manufactured pressed steelware in the United States, Acquisition of AllianceWare completed the company's line of plumbing products and its ability to manufacture them.

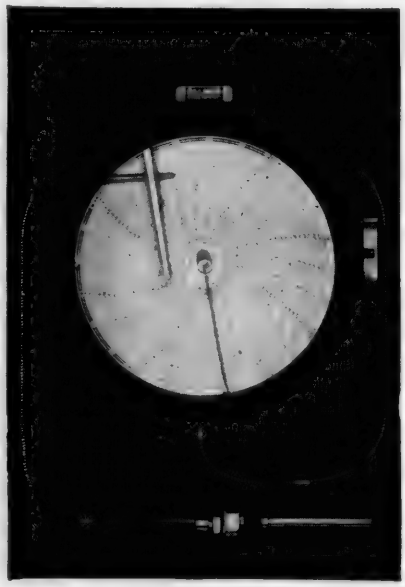
Crane Co. also announced the purchase of substantially all the assets of the Deming Company, Salem, Ohio. Deming, one of the best known pump manufacturers in the United States, was founded over 100 years ago. D. C. Fabiani, executive vice-president of Crane Co., said that the acquisition of Deming was another step in the company's planned program of expansion in the field of flow control for both home and industry. According to Mr. Fabiani, addition of Deming's extensive manufacturing facilities in Salem, Ohio; Rogers, Arkansas and Monterrey, Mexico will permit Crane Co. to enter the industrial pump business for the first time in the United States and Mexico. . . .

B-I-F INDUSTRIES (automatic flow control, measurement, weighing, engineered systems for many

PALMER

MERCURY ACTUATED RECORDERS

Into this modern Mercury Actuated Recorder has gone all the skill of Palmer Master Craftsmen



Readings are clearer, smoother and more precise than ever thought possible. In fact readings are so amazingly improved that maintenance is never needed under normal uses.

Recording Thermometers feature twelve inch die-cast aluminum case with black wrinkle or white satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges: —40 to 1000°F. or Equivalent in °C.

Send for Bulletin No. 45
Consult your Classified Directory

PALMER

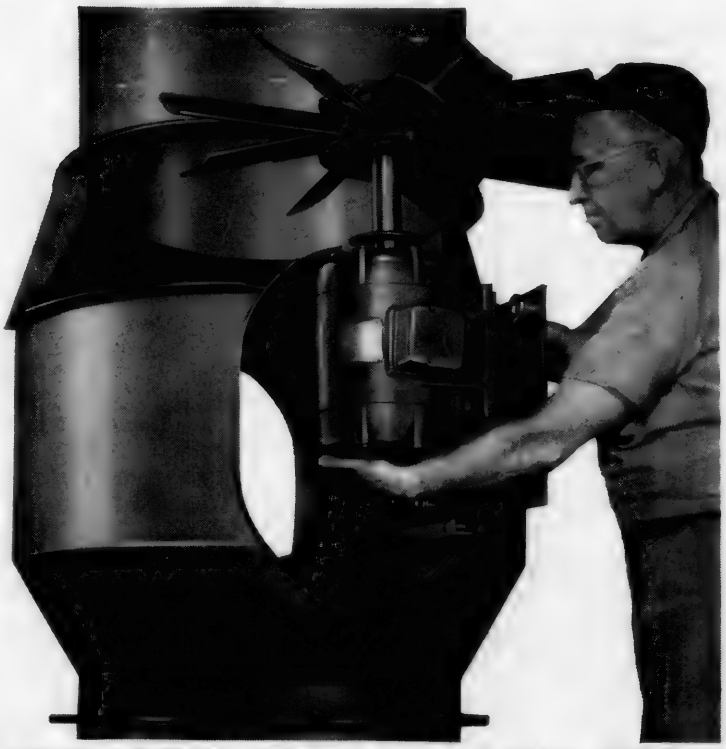
PALMER THERMOMETERS, INC.
Mfrs. of Industrial Laboratory, Recording and Dial Thermometers
Cincinnati 12, Ohio

process industries, water works and sewage and industrial waste treatment plants) is now a division of THE NEW YORK AIR BRAKE COMPANY. It continues in Providence, R. I., under the same operating management. As a member of The New York Air Brake family, B-I-F is now associated with Aurora Pump, Feedback Controls, Hydreco, Kinney Vacuum, and expanding operations in The New York Air Brake facilities in Watertown, N. Y. . . .

Plans for a $700,000, 31,500 square-foot addition to THE TRANE COMPANY Engineering Building at 17th and Horton Streets in La Crosse, Wis., was announced by the company. The expansion will provide needed office space for engineering and administrative departments, officials said. . . .

More than twenty editors and journalists representing twelve trade and professional publications in the plumbing, heating and air conditioning industry were guests at a press party given by LAWLER AUTOMATIC CONTROLS, INC., in their Mt. Vernon plant on July 19. The Press inspected a recent expansion of manufacturing facilities, rounding out a complete city block front in Mt. Vernon. Lawler acquired an additional building and parking lot adjoining the original one-story plant building. The new structure, a three-story building, now houses the general offices and two floors of manufacturing. In all, manufacturing space has been doubled. . . .

H. K. PORTER COMPANY, INC., Pittsburgh, Pa., announced the purchase of the National Cornice Works, Inc., Los Angeles, Calif. The firm is primarily a manufacturer of fans and blowers used for commercial and industrial ventilation, and marketed under the "Master Fan" trademark. National Cornice Works, nearly half a century old, will be operated as a wholly-owned subsidiary of Porter. Its engineering and sales forces will work closely with those of Peerless Electric Division of H. K.



SLIDE-OUT MOTOR AND FAN* cut your maintenance costs

Simply removing patented half-section of cone (left) allows motor-and-fan assembly to slide on rails (above) right out of DeBothezat Bifurcator for quick and easy inspection and maintenance. Bifurcator housing, originally installed as a section of the duct work, remains in place. This ease and convenience result in quick work which sharply cuts your maintenance costs.

DIRECT DRIVE CUTS COSTS, TOO

Direct drive eliminates inefficiency and maintenance problems of belts, yet motor operates in cool, clean air. Twin ducts of Bifurcator carry abnormally hot, corrosive or explosive fumes **around** motor, isolate it from destructive fumes handled by direct-drive exhaust fan. Fan wheels available from 12" to 48".

*Optional extra. Patents Pending.

Write for illustrated Bulletin DB-7-61

De Bothezat®

DE BOTHEZAT FANS DIVISION OF

American Machine and Metals, Inc.

Dept. ACH-961, EAST MOLINE, ILLINOIS

Divisions of American Machine and Metals, Inc.

TROY LAUNDRY MACHINERY • RIEHLE TESTING MACHINES • DE BOTHEZAT FANS • TOLHURST CENTRIFUGALS • FILTRATION ENGINEERS • FILTRATION FABRICS • NIAGARA FILTERS • UNITED STATES GAUGE • AUTOBAR • AUTOMATIC DEVICES • LAMB ELECTRIC COMPANY • HUNTER SPRING COMPANY • GLASER-STEERS CORPORATION

Be Wise . . . Use
KENCO®
The First and Finest Submersible
PUMPS
with these exclusive pump values

Patented
VAC-TROL
Only KENCO has this new manual/automatic control

COMPLETE LINE
- For every sump pump need
- 600 to 8600 GPH
- 12 Models
- 115-v./230-v. single phase
- 230-v. 3-phase industrial
- Variable turn on up to 18 ft.

SINGLE WARRANTY
All parts guaranteed by KENCO—no "double" warranties.

NATIONWIDE
Chain of Service Centers —factory trained and supervised.

EASIEST to install
- No floats to adjust
- No rods to foul up
- No water level worries

Just plug it in any 115-v. outlet, connect discharge pipe and it's ready to go.

See Your Full Service Wholesaler

KENCO PUMP
Division of The American Crucible Products Co.
Avenue • Lorain, Ohio

Briefly Stated

Porter Company, Inc. at Warren, Ohio. National Cornice is one of the largest producers of industrial size fans and blowers on the West Coast.

NEW REPRESENTATIVES

Technical Engineering Co., Houston, Tex., has been appointed sales representative in East Texas and Louisiana for the LEHIGH FAN AND BLOWER DIVISION of FULLER Co., Catasauqua, Pa. The line of industrial exhausters, induced draft fans and backward inclined blade fans will be handled by N. E. Zachariah, president of Technical Engineering. . . .

Carleton-Stuart Corporation, exclusive Carrier distributor in New York City for 16 years, has broadened its services to include the entire JACKSON & CHURCH warm air equipment line. Jackson & Church is a division of YORK-SHIPLEY, INC. . . .

GENERAL BLOWER CO., Morton Grove, Ill., manufacturer of industrial and material handling equipment, has appointed The Rainey Company, 3215 Mercer St., Houston, Tex., as its new sales agency. The agency specializes in sales to chemical manufacturers, oil refineries, gas processors, industrial users and heating and ventilating industries. (General Blower is a subsidiary of Ilg Electric Ventilating Co., Chicago, Ill.) . . .

Formation of a new wholesale firm, Warren Distributing Company, Phoenix, Ariz., to sell medium-size commercial and industrial air conditioning equipment in the Phoenix area, was announced by CARRIER AIR CONDITIONING COMPANY. J. S. "Cliffe" Warren, former vice-president and manager of Black & Ryan Air Conditioning Company of Phoenix, is president of the new firm which will be a distributor of Carrier equipment for custom engineered air conditioning systems. Black & Ryan will continue as wholesale distributor of packaged air conditioning units, with H. J. Marchant as sales manager. . . .

New!
SERIES 500
ELGIN
WATER SOFTENER

Elgin Quality at Amazingly Low Price!

Here is your final answer for those commercial jobs where water softener dependability is a must, but price is often a deciding factor.

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Representatives in Principal Cities
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Briefly Stated

Allen-Mitchell & Co., 1053 31st St., N. W., Washington, D. C., has been named Washington sales representative for GENERAL BLOWER Co., Morton Grove, Ill., manufacturer of industrial air and material handling equipment, a subsidiary of Ilg Electric Ventilating Co., Chicago, Ill. . . .

THE HOUSTON COMPANY, with sales offices located at Lubbock and Odessa, Tex., has been reorganized *and will be known as* C. H. E. INCORPORATED. C. H. E., Incorporated are manufacturer's representatives for the York Corporation, Loren Cook Company, Titus Manufacturing Corporation, Buensod-Stacey, Inc., Bryan Steam Corporation, Industrial Acoustics Company, Inc., Thermal Engineering Corporation, American Coolair Corporation, Airfloor Supply Company of California, General Rubber Corporation and Vibration Eliminator Company. The new firm will maintain their home office at 2109 Avenue Q, Lubbock, Texas under the management of C. P. Houston; the Odessa, Texas office will remain with Jess Colbert as manager. A new office will soon be opened in Amarillo, Tex. with Ed Eubank as manager. . . .

Appointment of Process Equipment Engineers, Plainfield, N. J., as representative for LEHIGH FAN AND BLOWER DIVISION of FULLER CO. was announced. The firm will handle both sales engineering and customer service for Lehigh in New Jersey, New York and Western Connecticut. Product line consists of industrial exhausters, induced draft fans and backward inclined blade fans. . . .

Appointment of Currise & Carlson, Indianaolis sales firm, to handle the John J. Nesbitt, Inc., Philadelphia, Pa. product line of heating, ventilating and air-conditioning equipment in the state of Indiana, was announced. The firm plans to open another office in either Fort Wayne or South Bend, January, 1962 at which time they will handle the complete Nesbitt line including school house products. . . .

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391 Standard Models To Choose From
PLUS Complete Facilities To Design And Manufacture Special Ventilators

BURT VENTILATOR	TYPE	CAPACITY (CFM)	SIZES	MODELS	DISCHARGE
FREE-FLOW GRAVITY	Gravity	113 to 35,560	16	16	Upward
LO-HYT GRAVITY	Gravity	AS REQUIRED	18	18	Downward
MONITOR	Gravity	MADE TO ORDER		1	Upward
MONOVENT (Ridge)	Gravity	48 to 5,184	15	15	Upward
REVOLVING	Gravity	123 to 10,931	17	17	Sideward
STANDARD GRAVITY	Gravity	35 to 24,890	19	19	Upward
THERMAVENT	Gravity	MADE TO ORDER		2	Upward
CENTRIFLOW	Power	65 to 36,430	56	184	Downward
FREE EXHAUST FAN	Power	5,000 to 75,550	7	17	Upward
FREE FLOW FAN	Power	1,040 to 99,050	15	35	Upward
LOW TYPE	Power	337 to 47,400	15	60	Downward
STANDARD FAN	Power	685 to 15,000	10	10	Upward

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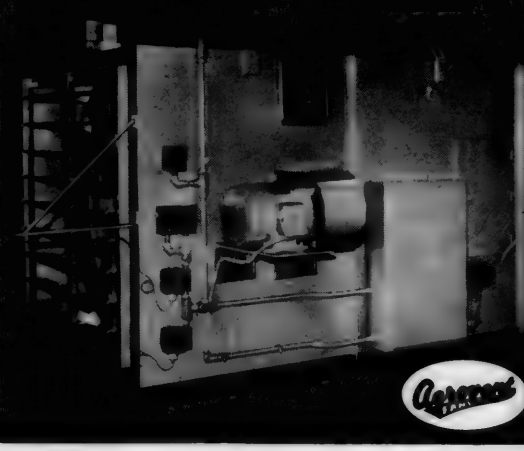

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BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

COMPRESSED AIR (AMERICAN)—A new and expanded edition of *Compressed Air and Gas Handbook* is available from Compressed Air and Gas Institute, 55 Public Square, Cleveland 13, Ohio. Developed, edited, and printed by the Institute's Publishing Board, data are presented in curves or tables, whenever possible, to facilitate use. Whether the subject is large-capacity centrifugal compressors for the chemical industry or multiple pneumatic tools, automatic feeds, and air gaging for manufacturing, the engineer will find an up-to-date discussion in the book. With 592 pages, 6 x 9 inches, the book is priced at $8.

COMPRESSED AIR (BRITISH)—The fifth edition of its *Technical Reference Book of Compressed Air Terms and Standards* marks the 30th year that this major reference work on British practice in the selection, installation, testing, utilization and maintenance of compressed air equipment has been published by the British Compressed Air Society. Hard bound, 113 pages, 8½ x 11 inches, price is 30/— postage free by surface mail from the Society at 32 Victoria St., London, S.W.1, England.

ABSORPTION CYCLE—A new study of the relationship between chemical structure and efficiency of the absorption-refrigeration cycle has been completed by American Gas Association. The project's aim was to investigate the influence of chemical structure on thermodynamic properties, such as vapor pressure, heat capacity, and activity coefficient of solutions. Research was conducted for AGA by Prof. Donald H. Andrews and Mr. Raymond A. Rousseau of John Hopkins University. Copies of the report, *Solution Thermodynamics for Absorption Refrigeration*, Cat. No. 5/ACR, are available at $1.50 from Order and Billing Dept., American Gas Association, 420 Lexington Ave., New York 17, N. Y.

RECIPROCATING REFRIGERATION—A revised edition—the 22nd printing—of the *Reciprocating Refrigeration Manual* has been published by The Trane Company. This fourth revision of the manual is a basic source of refrigeration information for engineers, contractors and trade schools. The handbook contains a rewritten and expanded section of pipe-sizing tables and data on the basic properties of saturated Refrigerant-12 and Refrigerant-22. This refrigeration information includes pertinent details on unloading mechanisms and thermostatic expansion valve tables. Copies of the manual can be obtained for $2.50 by writing The Trane Company, La Crosse, Wis.

HEATING MARKET STATISTICS—A report of the Building Materials Div., Business and Defense Services Administration, Department of Commerce, Washington 25, D. C., on *Installation of Selected Heating Equipment in 1959* gives the proportion of certain types of heating equipment that were installed in connection with replacement and modernization. Data were developed separately for each of the nine Census geographic divisions. This is the first extensive survey completed in an effort to fill this particular statistical and informational gap, according to the Department, which hopes that these data will assist those interested in heating equipment in making sales and other management decisions. Report is reprinted from *Construction Review*, April, 1961, a publication of the Department of Commerce.

CONTROLLING THE FLOW OF STEAM

(Continued from page 104)

Field tests have confirmed that, when plugs are correctly sized, the equal-percentage valve shows excellent stability under *light* load conditions. Under *heavy* load conditions, stability is acceptable with bleed-type controllers, but it has a tendency to hunt with non-bleed controllers if the throttling range is not increased beyond the usual setting.

On the other hand, the modified linear plug shows acceptable stability under all load conditions with the non-bleed controller, and only a slight increase in a tendency to oscillate near the light-load condition with bleed controllers.

When valve plugs are oversized, unstable operation is found to be characteristic with the equal-percentage plug *regardless of the type of controller used* unless *excessive* throttling range settings can be tolerated. The modified linear plug also shows a tendency toward instability but can be compensated for with a *slight* increase in throttling range setting.

Conclusions

(1) For steam-supplied heating coils best results are obtained with a correctly sized modified linear valve and a non-bleed controller.

(2) An equal-percentage valve will give good performance on direct-acting control of steam coils if a bleed controller is used and (again) if the valve is correctly sized. Here, oversizing the valve plug will have a more harmful effect on control.

(3) Because most valves are oversized, the modified linear valve will give improved control of most steam-to-air heat exchangers.

(4) To correct oversizing in the field, reduced size plugs and seats are available in the modified linear plug design for field replacement.

Although steam-to-water heat exchangers were not covered in this article, an analysis of the load will show that the new modified linear plug will give improved control here, too.

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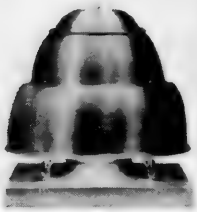

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Over 1,000,000 Liquid Eyes Sold to Date!

What Readers Say:

Do Plenums Waste Power?

(Continued from page 8)

. . . Statements in the article with reference to plenums and Fig. 7 and 8 are rather abreviated and only intended to illustrate the basic statement that any change in cross section of duct should be gradual. I might add that it should, if possible, be in one direction. This is true because every change in velocity means a transfer of energy from velocity to pressure or vice-versa and all such changes result in some loss. An increase in cross section must be very gradual if the transfer from velocity to static is to be reasonably efficient.

If the discharge from a two-fan conditioner is to go to one duct, the connection should be made as shown at *A* (not as shown at *B*).

In my opinion a connection made as shown in Fig. 8 will give the indicated results. Although the velocity over the whole face of the fan discharge is not uniform, it does not usually vary seriously along the fan axis. The important variation is from the part of the discharge farthest from the fan axis to that nearest to the axis. The air delivery of the identical size and speed fans will be near enough to equal. Of course, it is important that the amount of air to each of the three branches be equal and with the same static pressure at the point of separation. If independent volume control of the three branches is desired, such a connection as Fig. 8 would not be recommended. A better arrangement for that requirement is shown at *C*.

Some of the apparent difference of opinion between Mr. Markert and the writer may be due to our interpretation of the word "plenum." What is shown at *C* might be called a plenum and I am in favor of that type. As I understand the usual "plenum," it is a part of the duct which has a lower velocity than that in the ducts discharging into it or those branching from it. In general, I do not recommend such a plenum. Mr. Markert indicates in the last sentence of his letter, a place where a plenum must be used. In such a case, the velocity in the plenum, during full flow conditions, should preferably be between the fan outlet velocity and that in the branches.

Mr. Markert's recommendation of vanes, in some cases, is certainly desirable where these vanes help guide the air flow pattern in the smoothest manner, avoiding turbulence and helping to make any changes in velocity as gradual as possible.

I appreciate Mr. Markert's comments and they are certainly illustrative of what I am trying to encourage, i.e. thought in design and not merely thoughtless repetition of past practices.

Melvin A. Ramsey

Consulting Engineer
Worthington Corporation
East Orange, N. J.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

INTERNATIONAL CONFERENCE—The International Heat Transfer Conference will be held at the University of Colorado, Boulder, Colorado. Nonmembers are welcome. For information write: The American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y. .....**AUGUST 28-SEPTEMBER 1, 1961.**

SOUTHEASTERN SHOW AND SEMINAR—The meeting of the third Southeastern Show will be held at the War Memorial Coliseum, and the third Southeastern Seminar at the adjoining Town Hall, Greensboro, N. C. Robert E. Zimmerman, show manager, Box 3173, Greensboro, N. C. J. R. Ogburn, Seminar chairman. Box 907, Raleigh, N. C. .....**SEPTEMBER 12-14, 1961.**

ASME CONFERENCE—The 9th annual joint Engineering Management Conference, sponsored by the professional engineering societies, will be held at the Hotel Roosevelt, Madison Ave. at 45th Street, New York City, N. Y. Wallace J. Richardson, Chairman. .....**SEPTEMBER 14-15, 1961.**

INDUSTRIAL BUILDING EXPOSITION—Nineteen conference sessions, covering problems of large and small companies will feature the second Industrial Building Exposition and Congress at the New York Coliseum. For details write to Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y. ....**SEPTEMBER 25-28, 1961.**

WELDING FALL MEETING—The American Welding Society fall meeting will be held in the Adolphus Hotel, Dallas, Texas. For details write to the Information Center, American Welding Society, 33 West 39th St., New York 18, N. Y. ..**SEPTEMBER 25-28, 1961.**

A.G.A. MEETING—A meeting of special interest to the air conditioning and refrigeration industry, will be held by the American Gas Association at its Annual Convention, at Dallas, Texas. ....**OCTOBER 2-4, 1961.**

CORROSION ENGINEERS CONFERENCE—Five regional conferences of the National Association of Corrosion Engineers will meet this Fall. Meetings will be held as follows:
Western Region, Portland, Oregon. .....**OCTOBER 4-6, 1961.**
North Central Region, St. Louis, Mo. ....**OCTOBER 9-11, 1961.**
South Central Region, Houston, Texas. ..**OCTOBER 24-26, 1961.**
Northeast Region, New York, N. Y. ....**OCTOBER 30-NOVEMBER 2, 1961.**
Southeast Region, Miami, Florida. ....**NOVEMBER 27-DECEMBER 1, 1961.**
For information write T. J. Hull, Executive Secretary, 1061 M & M Building, Houston, Texas.

WESTERN BUILDING EXPOSITION — The 1961 Western Building Industries Exposition to be held at the Los Angeles Great Western Exhibit Center, will be presented by the American Institute of Architects, Southern California Chapter, sponsored jointly with WBIE. For information write: A. Byron Perkins & Associates Inc., 2216 South Hill Street, Los Angeles 7, Calif. ....**OCTOBER 7-10, 1961.**

INDUSTRIAL HYGIENE FOUNDATION—The 26th annual meeting of the Industrial Hygiene Foundation of America Inc. will be held at the Mellon Institute, 4400 Fifth Avenue, Pittsburgh 13, Pa. Dr. H. H. Schrenk, Managing Director, 4400 Fifth Avenue, Pittsburgh 13, Pa. .....**OCTOBER 25-26, 1961.**

CONSULTING ENGINEERS COUNCIL—Semi-annual meeting of CEC Board of Directors, Miami Beach, Fla. Larry N. Spiller, executive secretary, 322 Reisch Bldg., Springfield, Ill. ....**NOVEMBER 2-4, 1961.**

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Flange or pedestal mount optional

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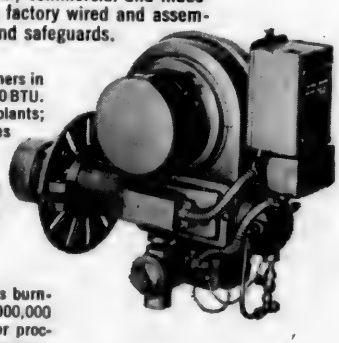

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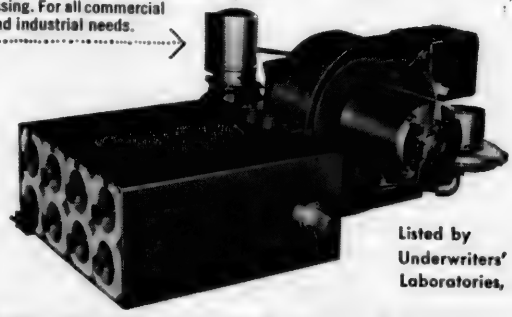

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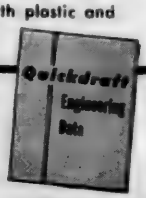

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Coming Events

(Continued from page 151)

R.S.E.S. INTERNATIONAL CONVENTION—The 24th annual Refrigeration Service Engineers Society International Convention will be held at the Royal York Hotel, Toronto, Ontario, Canada. Information: Convention Committee Secretary, M. F. Peddie, 51 Haven St., Toronto 19, Canada. .....**NOVEMBER 2-5, 1961.**

NATIONAL WARM AIR—The 48th Annual Convention will be held at the La Salle Hotel, Managing Director, James M. Martin. National Warm Air Heating and Air Conditioning Association, 640 Engineers Building, Cleveland 14, Ohio. ....**NOVEMBER 6, 1961.**

BRI FALL CONFERENCES—Building Research Institute Spring Conferences, Shoreham Hotel, Washington, D. C. BRI, 2101 Constitution Ave., Washington 25, D. C. ....**NOVEMBER 14-16, 1961.**

NEMA MEETING—The 35th annual meeting of the National Electrical Manufacturers Association will be held at The Plaza Hotel, New York City, N. Y. For information write Russell Gingles, Director of Public Relations, 155 East 44th Street, New York 17, N. Y. .....**NOVEMBER 16, 1961.**

CHEMICAL INDUSTRY EXPOSITION—The 28th Exposition of Chemical Industries will be held at the New York Coliseum, under the management of the International Exposition Co., 480 Lexington Ave., New York 17, N. Y. E. K. Stevens, manager. .....**NOVEMBER 27-DECEMBER 1, 1961.**

BHC COUNCIL MEETING—The sixth annual meeting of the national Better Heating-Cooling Council will be held at the Hotel Delmonico, New York City, N. Y. For information write Ray Schumack, 250 Park Ave., New York 17, N. Y. .....**DECEMBER 18-19, 1961.**

ARI EXPOSITION—Air Conditioning and Refrigeration Institute, 12th Exposition, Pan-Pacific Auditorium, Los Angeles. Information: George E. Mills, ARI Show Director, 1346 Connecticut Ave. N.W. Washington 6, D. C. .....**FEBRUARY 12-15, 1962.**

ELECTRIC HEATING SHOW—The Second National Electric House Heating Symposium and Exposition, sponsored by Electric House Heating Section, National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N. Y., to be held at the Sherman Hotel, Chicago, Ill. Write Russell Gingles, NEMA director of public relations. .....**MARCH 19-21, 1962.**

NACE ANNUAL CONFERENCE—18th Annual Conference and 1962 Corrosion Show of the National Assoc. of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas, to be held in Kansas City Auditorium with the Muehlebach Hotel as headquarters. T. J. Hull, Executive Secretary. Overall charge of both the conference and corrosion show L. W. Gleekman, Wyandotte Chemical Corp., Wyandotte, Michigan. .....**MARCH 19-23, 1962.**

AMERICAN INDUSTRIAL HYGIENE CONFERENCE—Exhibits and Conference under the joint sponsorship of the American Industrial Association and the American Conference of Governmental Industrial Hygienists, will be held at the Sheraton Park Hotel, Washington, D. C. William S. Johnson, Medical Div. Bethlehem Steel Co., Bethlehem, Pa. .....**MAY 13-17, 1962.**

ASTM ANNUAL MEETING—Annual Meeting of the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., at Statler Hotel, New York City, in conjunction with apparatus exhibit. .....**JUNE 24-29, 1962.**

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Mechanical Engineer with extensive air conditioning design experience and B.S.M.E. degree required by established consulting engineering firm located in South Florida. Reply giving complete resume and salary requirements. Box 985, Air Conditioning, Heating & Ventilating, 93 Worth Street, New York 13, N. Y.

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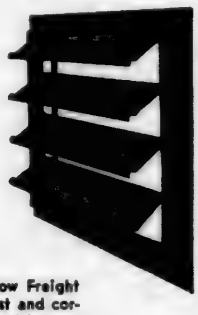

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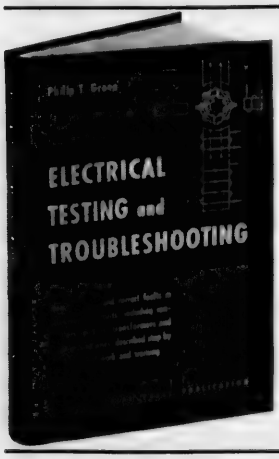

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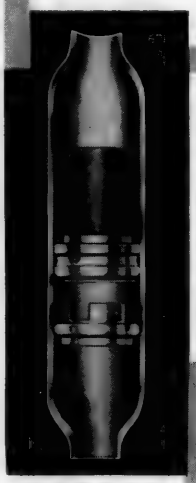

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Use this Digest to locate and refer to the advertisements in which you are particularly interested; then fill out and mail a prepaid postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

IRON BODY GATES are available from Jenkins Bros. and offer a big bargain in true value. A complete line is available from the firm.
Inside Front Cover Item 200

STEAM TRAPS often have to handle air and Armstrong Machine Works offers traps with super air venting capacity. Steam trap book is available.
Page 1 Item 201

ROOF MOUNTED EQUIPMENT from Atmos-Pak Inc. solves problems of cooling and heating one-story buildings. Literature is offered.
Page 2 Item 202

BIG BURNERS from The Carlin Co. are called big in every way. These oil burners provide big capacity, big performance and big value. Information is available.
Page 5 Item 203

AIR DUCT made entirely of fiber glass insulation within an aluminum casing provides many performance advantages. Manufacturer, Gustin-Bacon, offers detailed information.
Pages 6-7 Item 204

RADIANT PANEL HEATING with Anaconda's preformed panel grids is the subject of booklet C-6 offered by the company.
Page 9 Item 205

FLUSH VALVES made by Delaney are installed in new Western Electric Co. office building. Write on company letterhead for catalog 66.
Page 11 Item 206

PACKAGED BOILERS from Superior Combustion Industries have four-pass design which provides long-lived efficiency for both steam and hot water. Catalog S-19 is offered.
Page 13 Item 207

COOLING TOWER SILENCERS are just part of the line of sound control devices offered by Koppers Co. Inc. Complete technical information on line is available.
Page 14 Item 208

LOW VELOCITY DUAL DUCT UNITS from Carnes Corp. shrink costs, simplify duct work, multiple zones and increase efficiency. Catalog No. 1361 is offered.
Pages 16-17 Item 209

TEMPERATURE CONTROL SYSTEM from Spence Engineering Co. gives unusual control accuracy. Bulletin 9 is available.
Page 18 Item 210

HEATER SECTIONS for freeze-proof air conditioning, preheating and tempering applications are described by L. J. Wing in Bulletin IFB-61.
Page 19 Item 211

WETTED DECK SURFACE on Halstead & Mitchell cooling towers has a 20-year guarantee. Bulletins EC-500 and ECKB-601 are offered.
Page 20 Item 212

NINE BOOSTER PUMPS from Bell & Gossett provide controlled comfort in St. Lawrence Seaway Corporation's Administration Building.
Page 21 Item 213

HEAT PUMPS from Carrier are said to be practical for plant heating even in colder climates. Information is available.
Page 22 Item 214

HEATING PUMPS from Skidmore Corp. provide smooth, dependable operation and are described in Bulletin No. 10-C.
Page 23 Item 215

DUAL DUCT air mixing unit from Buensod-Stacey Corp. maintains constant air volume regardless of static pressure variance.
Page 24 Item 216

DOUBLE SUCTION PUMP manufactured by Chicago Pump is new, quiet and vibrationless. Single stage packed unit is described in Bulletin 102-A.
Page 25 Item 217

TEMPERATURE REGULATORS from Lawler Automatic Controls put quality where it counts most. Self-contained control valves are available for every application.
Page 26 Item 218

AIR COOLED PACKAGED UNIT has been added to the self-contained line manufactured by Governair. An informative folder is available.
Page 27 Item 219

SOUND CONTROL CURB made by Jenn-Air absorbs 90% of an exhauster's sound power at inlet. Company offers bulletin 601-SC.
Page 28 Item 220

PACKAGED BOILERS from Ray Burner Co. are specified where noise could be a nuisance. Units are insulated for quiet operation.
Page 29 Item 221

ELECTRIC STORAGE WATER HEATER is offered as a standard package unit by Patterson-Kelley for commercial, industrial and institutional use. Catalog No. P-KW-1 is available.
Page 30 Item 222

ELECTRONIC AIR CLEANING is employed by Polaroid to keep picture rolls dust-free. Preciptron brochure is available from Westinghouse Electric Corp.
Page 31 Item 223

AIR MOVING EQUIPMENT from Peerless Electric Div. is engineered and tested to provide controlled performance. Information is available.
Page 32 Item 224

YEAR ROUND AIR CONDITIONERS from John J. Nesbitt Inc., has humidity control systems which protect against excess humidity. Publication 602 is offered.
Pages 33-36 Item 225

HEATING EQUIPMENT from Edwards Engineering is described in question-answer type ad. Handbook-catalog and engineers' portfolio are offered.
Page 37 Item 226

PNEUMATIC CONTROL from Johnson Service Co. is specified where controlled environment counts, as in the new Union Carbide Technical Center.
Pages 38-39 Item 227

TOTALLY ENCLOSED HERMETIC PUMPS are available from Buffalo Pumps Div. with self-adjusting bearings Bulletin 977 contains full information.
Page 41 Item 228

FIBER GLASS PIPE INSULATION from Pittsburgh Plate Glass Co. installs 15% faster than other pipe insulating materials, ad states. Full information is available.
Page 42 Item 229

STEAM GENERATORS and hot water generators from Petro provide a better way to make heat. They feature precision control of entire combustion process. Literature is offered.
Page 43 Item 230

FLEXIBLE ANTI-SWEAT INSULATION designed for quick installation on bent tubing is called Aerotube by Johns-Manville. Details are available.
Pages 44-45 Item 231

AIR HANDLING UNITS called Torrivent by Trane Co. solve large area heating and ventilating problems. Expanded size range is announced; information is available.
Pages 46-47 Item 232

FLUSH VALVES from Sloan Valve Co. are called performance proven and time tested. They were selected for Four Gateway Center building in Pittsburgh.
Page 48 Item 233

Ad-Digest

FORCED DRAFT FIRING increased boiler capacity 70%, yet will return investment in seven years for Minnesota Masonic Home. Iron Fireman offers information.
Page 49 Item 234

DOUBLE-DUCT CONTROL UNITS from Barber-Colman provide tight shutoff, extreme simplicity and lower sound levels in high velocity air control. Information is available.
Pages 50-51 Item 235

COPPER TUBE BOILERS from Bryan Steam Corp. keep pace with temperature changes in a California junior high school. They do the job efficiently, economically.
Page 52 Item 236

UNDERGROUND HOT PIPES are economically insulated and protected by Gilsulate, product of American Gilsonite Co. Information is available.
Page 53 Item 237

TEMPERATURE CONTROL is more accurate, sensitive and colorful with the new Honeywell thermostat. Note color page in ad.
Pages 54-55 Item 238

CAST IRON BOILERS from Weil-McLain have compact design and quiet operation which permit flexibility in location. Bulletin C-297 is offered.
Page 56 Item 239

CARRIERS are available from Jay R. Smith to support any fixture off the wall. 100 types and sizes are available; carrier selection guide is offered.
Page 57 Item 240

AUTOMATIC AIR VENTS for hydronic heating and cooling systems are described in a catalog offered by manufacturer, Maid-O-Mist Inc.
Page 125 Item 241

CLASSROOM CLIMATE with Lennox's Comfort Curtain provide full room air circulation, guarantees room-wide comfort. Information is available.
Pages 126-127 Item 242

HEATING AND VENTILATING UNITS from McQuay Inc. provide extreme quietness and flaxibility. Complete information on these units is available.
Page 129 Item 243

AIR FLOW SYSTEMS can be balanced with reliability the first time by means of the Alnor Velometer. Other air measuring units are available from Illinois Testing Labs.
Page 130 Item 244

EXTERIOR STATIONARY LOUVER from A-J Mfg. Co. in rain and snow proof. Catalog is available.
Page 131 Item 245

EXTRUDED ALUMINUM DIFFUSERS from Air Devices Inc. provide adjustable, modulated diffusion. Roto-Jet diffusers are described in catalog RJ-100.
Page 133 Item 246

GALVANIZED SHEETS from Wheeling Steel are called "Tops for every shape" by sheet metal men. Information is offered.
Pages 134-135 Item 247

NEW PLANT of Anemostat Corp. of America combines finest, most efficient production and research facilities in the industry.
Pages 136 Item 248

TWO CONVENTIONAL BASINS do no more than the Duo washfountain made by Bradley Washfountain Co. Publication No. 1380 is available.
Page 137 Item 249

CHEMICAL MAINTENANCE PRODUCTS and consulting services are offered by Metropolitan Refining Co. Complete information is available.
Page 138 Item 250

ELECTRIC HEAT THERMOSTATS are designed by Mears Controls Inc. to provide excellent control in electrically heated houses, greenhouses, garages, etc. Control catalog is offered.
Page 139 Item 251

FLEXIBLE HOSE for dust collection, fume control and materials handling is manufactured by The Flexaust Co. Details are available.
Page 140 Item 252

GREASE FILTERS of a permanent, cleanable type are available from Air Filter Corp. for safer kitchen ventilation. Bulletins are offered.
Page 141 Item 253

SOLENOID VALVES with epoxy-clad coils are offered at no extra cost by Jackes Evans Mfg. Co. Information is available.
Page 141 Item 254

LOW COST PLANT HEATING is possible with Thermobloc direct-fire warm air heaters manufactured by Wanson Corp. Bulletin is available.
Page 141 Item 255

PROPER AIR CONDITIONING system design demands a "people comfort" factor. It is incorporated in the Hankison Series E air dryer. Bulletin 9300 is offered.
Page 142 Item 256

DUAL FUEL BURNER from Webster Engineering is called superior in any configuration. Literature is offered.
Page 142 Item 257

NEW TEMPERATURE CONTROL is announced by the Mercoid Corp. for refrigeration, air conditioning and freeze protection. Bulletin No. 0-28 is available.
Page 143 Item 258

WATER COOLERS from Cordley & Hayes were installed at Villanova University. Catalog 61 describes new line.
Page 144 Item 259

MERCURY ACTIVATED RECORDERS from Palmer Thermometers Inc. provide clear, smooth and precise readings. Bulletin No. 45 is available.
Page 144 Item 260

SLIDE-OUT MOTOR AND FAN permits quick and easy inspection and maintenance. DeBothezat's Bifurcator is described in Bulletin DB-7-61.
Page 145 Item 261

SUBMERSIBLE PUMPS from Kenco Pump offer exclusive pump values: New manual/automatic control; single warranty, and easy installation.
Page 146 Item 262

WATER SOFTENER from Elgin Softener Corp. is called the final answer for those commercial jobs where dependability is a must. Bulletin is available.
Page 146 Item 263

VENTILATORS are manufactured by The Burt Mfg. Co. in sizes and types to meet any ventilating problem that roof ventilators can solve. Complete line databook is offered.
Page 147 Item 264

AIR MAKE-UP UNITS from Aerovent maintain uniform temperatures and provide maximum efficiency. Bulletin 860 is offered.
Page 148 Item 265

FLAME RESISTANT TAPE from Arno Adhesive Tapes complies with all building codes. Information and a 15-ft. sample are offered by the firm.
Page 149 Item 266

AIR MOVERS have been added to the line of Greenheck Fan & Ventilator Corp. Latest catalog describes units.
Page 150 Item 267

POSITIVE SEALING INDICATORS are designed by Allin Mfg. Co. to save time and money. Catalog E-57 covers complete line.
Page 150 Item 268

GAS BURNERS are offered by Power Flame Div. in models to fit every application. Complete information is available.
Page 151 Item 269

POWER-DRAFT UNITS designed for residential, commercial and industrial applications are available from Quickdraft Corp. who offers engineering databook.
Page 152 Item 270

EXTRUDED ALUMINUM SHUTTERS are offered by Elgo Shutter & Mfg. Co. Catalog and specifications are available.
Page 153 Item 271

CHECK VALVE AND STRAINER combination by Watsco is specifically designed for split systems and heat pumps. Catalog is offered.
Page 153 Item 272

SHUT-OFF VALVES in globe and angle types are available in a complete range of sizes and types from Henry Valve Co. They offer full capacity flow.
Inside Back Cover Item 273

CONTROL APPLICATIONS for hot water and steam heating are covered in four how-to-it books offered by McDonnell & Miller Inc. See ad for details.
Back Cover Item 274

Advertisements in this issue are summarized on the Ad-Digest pages preceding this page. If you want more information on advertised products, locate the Digest item number of that advertisement, circle the item number on either of the post-cards provided below.

Use the post-cards below

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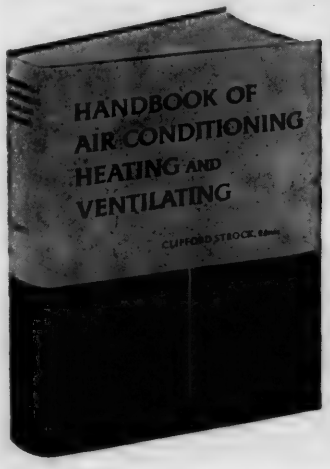
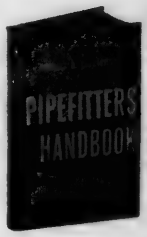


HANDBOOK OF AIR CONDITIONING, HEATING AND VENTILATING

Edited by Clifford Strock

Completely new book containing thousands of facts, figures, data and principles; hundreds of charts, tables and maps. Answers problems you face every day in your work. Subjects treated thoroughly include: Air Conditioning, Air Handling, Building Heat Loss, Climatic Data, Combustion, Degree-Days, Dual Duct Design, Dust Collection, Fuel Estimating, High Velocity Air, Mathematic, Motors, Piping and Plumbing, Psychrometry, Radiator Heating, Refrigerants, Service Hot Water, Solar Data, Steam Flow, Ventilation, Warm Air Heating, Terminology and a Complete cross index. **1094 Pages, 7¾" x 10¾", 598 Charts, Maps, Illus., 518 Tables, $15.00**



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Written by a pipefitter for pipefitters. Covers: Pipe Bending — Screwed Offsets — Mitered Joints — Dimensions—Screwed Fittings — Butt Welding Fittings — Flanges and Flanged Fittings—Solder Joint Fittings—U-Bolts—Spacing of Hangers—Water in Pipes—Pipe Expansion—Identification—Contents of Tanks — Valves — Plastic Pipe — Metals — Steam — Mathematical Data — Measures — Conversion Tables—Trigonometry—Field Layout of Angles — Dictionary. **416 Pages, 248 Illustrations, $6.00.**

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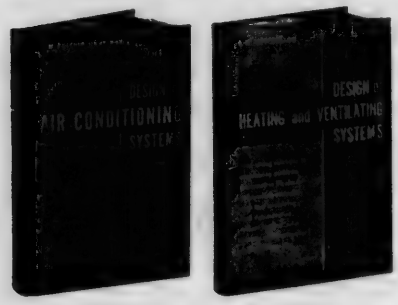
115 full-page charts solve problems of air conditioning system design involving cooling load, duct design, psychrometrics, solar energy, comfort conditioning, panel cooling, etc. For each chart the engineering and mathematical background plus design example and solution are given. **336 Pages, 118 Illus., $8.00.**



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COMBINATION OFFER

Both of the above books by Prof. F. W. Hutchinson, $14.00.

SUMMER AIR CONDITIONING

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Training text and reference book on residential air conditioning. Cover: Comfort Conditions — Summer Weather—The Sun in Relation to the House—Methods of Cooling—The Compressor System in Packaged Form —Fans—Duct Systems—Distributing Air in Rooms—Noise Control—Heat Gain in Houses—Designing Air-Duct Systems and Selecting Equipment — Operating Cooling Equipment — The Air-Conditioning Industry. **560 Pages, 266 Illustrations, $8.00.**

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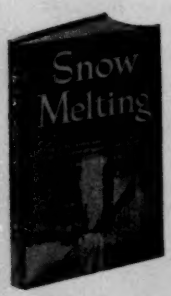

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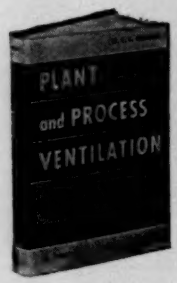

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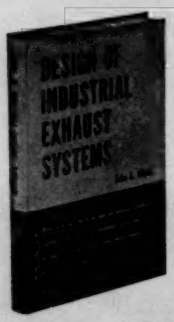

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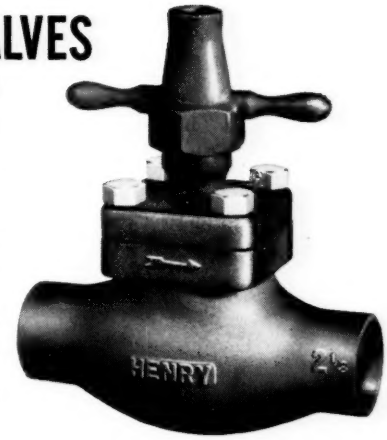

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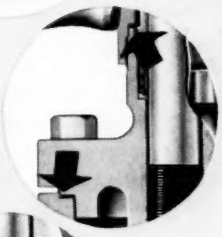

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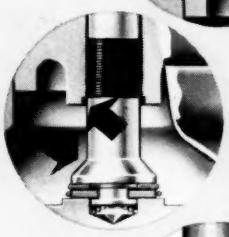

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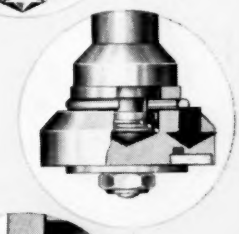

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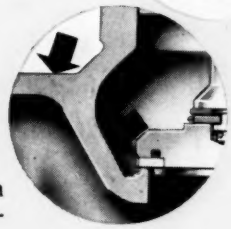

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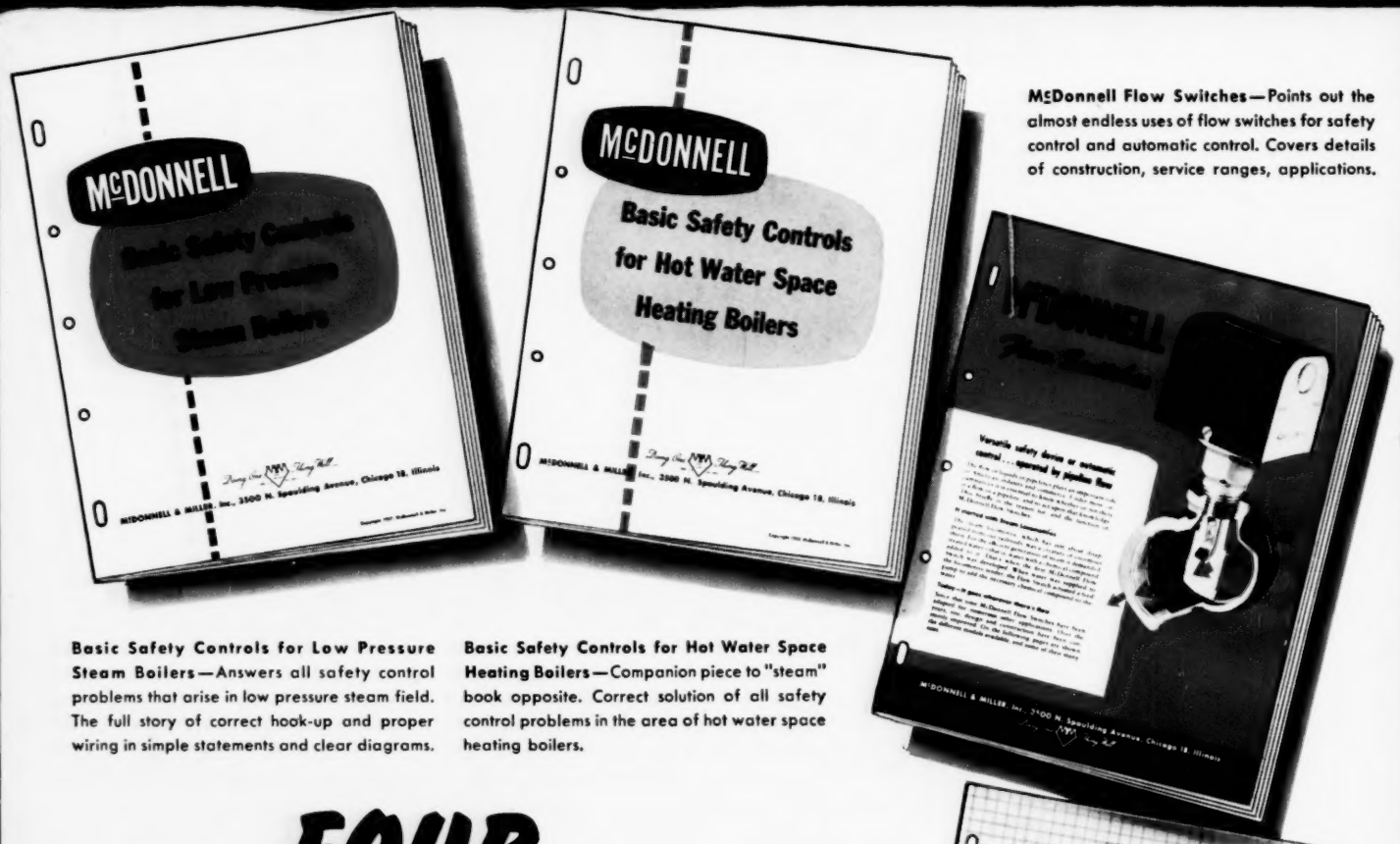

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